

47th INDIAN SCIENCE CONGRESS, BOMBAY, 1960

SECTION OF MATHEMATICS

PRESIDENT : PROF. V. G. IYER

Abstracts

Algebra

1. Characters of O_h^1 Space Group

T. VENKATARAYUDU and P. GOPALA KRISHNA MURTI, Waltair

Diamond belongs to the space-group O_h^1 and the characters of this group are useful in the study of the normal frequencies of the crystal. In the existing literature the characters of O_h^1 are available when the primitive Bravais translations have orders upto four only. In this paper the characters are obtained for translations of arbitrary order. Seitz (Ann. of Maths. 37, 17, 1936) showed that space-groups are solvable and all the representations of a solvable group G could be obtained from those of a maximum self-conjugate sub-group of G . Starting from an Abelian sub-group A of G and successively using the above method for every sub-group in the composition series of G containing A , one could obtain all the representations of G . This process could be considerably simplified by taking the sub-group $G(r)$ of G which keep a representation R of A invariant. $G(r)$ is not necessarily a self-conjugate sub-group of G . The representations of $G(r)$ which are built up from R are called non-spurious representations. Herring, (J. Franklin Inst. 233, 525, 1942) obtained only the non-spurious representations of O_h^1 using the laborious method of constructing the algebra of the conjugate classes. (Also see W. Doring and V. Zehler, Ann. Physik. 13, 214, 1953). Seitz's method may be adopted to obtain the representations of G directly from those of $G(r)$ using the monomial method. Taking in turn, the complete set of irreducible representations of the underlying Abelian Group A , all the representations of G are constructed.

Geometry

2. Matrix method of Analysing the General Finite Rotation in Hyperspace

N. N. GHOSH, Santiniketan

A $2r$ -dimensional finite rotation in a euclidean n -space is represented by an orthogonal transformation of the type $X' = \exp \Omega X$, where Ω is a skew-symmetric matrix of order n and rank $2r$. Making use of the characteristic equation of Ω , the transformation is reduced to a special form which involves a set of $2r$ functions expressed in series. When, however, the eigenvalues of the skew-symmetric matrix Ω are all distinct it is further shown that the $2r$ -dimensional rotation may be performed by means of r mutually independent plane rotations.

PROCEEDINGS OF THE FORTY-SEVENTH INDIAN SCIENCE CONGRESS

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3. Geometric and Harmonic Chains of Equal Spheres

SAHIB RAM MANDAN, KHARAGPUR

The fascinating method of Grassmann (H.G. Forder, 'Calculus of Extensions') employed in an earlier work, 'Harmonic chains of equal circles' (in press, Read at the 43rd Session of the Indian Science Congress Association held at Agra in Jan. 1956 and abstract published in its Proceedings) has led to the present development. We start with a *lemma* introducing an *s-point* of a tetrahedron on its Euler line symmetric of its circumcentre w.r.t. its Monge point. Then by use of symbols, we derive a good number of interesting results for a co-spherical pentad, hexad and finally (n) -ad ($n = 7, 8, \dots$) of points in 3 sections. For example :

The *s-points* of the 5 tetrahedra formed of a co-spherical pentad of points, form another, called its *s-pentad*, as its symmetric w.r.t. the mid-point of the join of their circumcentres such that their centroids lie at the 2 points of pentasection of this join, which is, therefore, called their *Euler line*, and either pentad can be derived from the other by the same operations, which, therefore, form a closed and finite transformation group of order two. 2 such pentads are, therefore, called *conjugate* to each other.

The Monge points and centroid, of the 5 tetrahedra of a co-spherical pentad of points, form 2 new similar pentads, called respectively its *M-* and *G-pentad*, inscribed in spheres of radii half and quarter its circum-radius, having the same Euler line such that its circumsphere is concentric with those of their conjugates.

The circumcentres of the *s-pentads* of the 6 pentads formed of a co-spherical hexad of points, form another, called its *s-hexad*, as its symmetric w.r.t. the mid-point of the join of their circumcentres such that their centroids lie at the 2 points of hexasection of this join, which is, therefore, called its *Euler line*, and either hexad can be derived from the other by the same operations, which, therefore, form a closed and finite transformation group of order two. 2 such hexads are, therefore, called *conjugate* to each other.

The circumcentres of the *M- and G-pentads* and the centroids, of the 6 pentads of a co-spherical hexad of points, form 3 new similar hexads, called respectively its *M-, G2- and G1-hexad*, inscribed in spheres of radii half, quarter and 1/5th its circum-radius, having the same Euler line such that its circumsphere is concentric with those of their conjugates.

Thus we extend our ideas in regard to a co-spherical (n) -ad of points, define its *conjugate* (n) -ad, and its *Euler line*, as the join of its circumcentre and centroid, by method of induction, and then introduce $n-3$ new similar (n) -ads, called its *M-, G1- and G(r+1)-(n)-ad* ($r = 1, 2, \dots, n-5$), inscribed respectively in spheres of radii half, $1/(n-1)$ th and $1/(n-r-1)$ th its circum-radius, having the same Euler line such that its circumcentre coincides with those of their conjugates.

4. Altitudes of an n -dimensional Simplex

SAHIB RAM MANDAN, Kharagpur

This paper is a continuation of a previous one*. To avoid repetition, a good number of propositions are just stated without proofs that follow the line of arguments adopted

in the said paper. But at places repetition of the argument becomes necessary for the sake of clarity of ideas. Many a proposition are established by the method of induction. The altitudes of a general simplex are observed to meet the $(n-2)$ spaces perpendicular to its plane faces at their orthocentres such that $\binom{n}{3}$ of them are parallel to each altitude. The normals to the prime faces of a general simplex at the points, that divide the segments between their S -points (Monge points) and the feet of its respective altitudes to them in the ratio $1 : (n-2)$, CONCUR at a point that we name as the S -point (Monge point) of the simplex. The $\binom{n+1}{2}$ planes perpendicular to the $(n-2)$ faces of a general simplex, from the points that divide the segments between their S -points and the midpoints of its edges opposite them in the ratio $2 : (n-3)$, CONCUR at the S -point of the simplex. The centroid of a general simplex is collinear with its S -point and circumcentre, and divides their join, in the ratio $2 : (n-1)$, that is termed as its *Euler line*, in analogy with spaces of lower dimensions. Before we introduce the orthocentric simplex and develop its properties connected with its r -altitudes and associated hyperspheres, we have to pass through a number of other special ones on the way and watch their behaviour rather carefully with some interest. Propositions of incidence and perpendicularity in an n -space are assumed and used very frequently.

Three special types are discussed here and the other two are developed in another paper, 'Uni-orthocentric and Demi-orthocentric Simplexes' (in press). *'The altitudes of a simplex in an n -space form an associated set of $n+1$ lines such that an $(n-2)$ space meeting n of them meets the $(n+1)$ th too, is under investigation.*

5. Desargues' Theorem in an n -Space

SAHIB RAM MANDAN, Kharagpur

A pair of $(r+2)$ -ads of points, T, T' , neither lying in an r -space and therefore either determining an $(r+1)$ -space which never has a solid common with the other, may be said to be *projective* from an $(r-1)$ -space, if it meets the $r+2$ joins of the points of T to those of T' , one to one. *T, T' are projective, if, and only if, the $r+2$ intersections of their corresponding r -spaces are collinear.* When $r = 1$, this becomes the well known Desargues' two-triangle theorem in a plane. Therefore we name it as *Desargues' theorem in a $(2r)$ -space ($r > 1$)* and prove it here too in the same synthetic style by making use of the axioms and the corresponding proposition of incidence of a $(2r+1)$ -space or with the aid of Desargues' theorem in a plane and the axioms of a $(2r)$ -space only. We may also use symbols to establish it, as we have done for it in a 4-space. Pairs of *projective* $(r+3)$ -ads, defined similarly, are also considered leading to an interesting configuration $2^{r-1}\binom{r+3}{3}$ 5-octahedra. The knowledge of the axioms of incidence of an n -space is assumed here.

6. Polarity for a Quadric in an n -space

SAHIB RAM MANDAN, Kharagpur

H. F. Baker (*Proc. Camb. Phil. Soc.*, 32(1936), pp. 507-20) proved *analytically* that the $n+1$ $(n-2)$ -spaces, common to the pairs of corresponding primes of a pair of

polar simplexes S and S' for a quadric Q in an n -space S_n , are *associated* such that they are met by ∞^{n-2} lines, one line through each point of each $(n-2)$ -space. Later J. A. Todd and H. S. M. Coxeter (Amer. Math. Mon., Vol. 51, 1944, pp. 599-600) also proved *analytically* the dually associated character of the $n+1$ joins of the pairs of corresponding vertices of S and S' as a solution of an advanced problem (No. 4079, *ibid*, Vol. 50, 1943, p. 264) proposed by S. Beatty. It is suggested by Coxeter (in the Editor's note there) that the same can be established *synthetically* by induction. This suggestion is followed up here to prove: 'If ∞^{n-3} $(n-2)$ -spaces, for n greater than 3, meeting n of the $n+1$ given lines A_iB_i of general position in S_n , pass respectively through each of 2 points A_n, B_n of the $(n+1)$ th line, the $n+1$ lines A_iB_i ($i = 0, 1, \dots, n$) are *associated* such that ∞^{n-3} $(n-2)$ -spaces meeting them pass through every point of every one of these lines.'

Incidentally we observe that $n(n+1)$ points, two on each edge of a simplex S in S_n , lie on a quadric, if, and only if, they lie, in $2^{n(n+1)/2}$ ways, in n -ads in the $n+1$ primes of another polar to S for a quadric. As a result, we derive the Pascal's theorem for a quadric in S_n after Chasles (*Aperçu historique*, 1837, Note 32, p. 400) and its dual Brinchon's, in analogy with those for a conic, leading to a system of $(n+1)2^n$ lines, 2^n through each vertex of S , such that each line belongs to $2^{n(n-1)/2}$ of $2^{n(n+1)/2}$ associated sets of $n+1$ lines each. However interesting the relations of the lines of a system, they are not treated here.

A number of special cases of some interest are noted explaining the novelties in the paper of Baker referred above. Self-conjugate r -ads for Q arising from degenerate cases are also discussed. The paper is divided into 2 sections, one devoted to 4-space only, the other deals with developments in higher spaces.

Differential Geometry

7. On a Type of Conformally Flat Riemannian Space

M. C. CHAKI, Calcutta

It is known that a Riemannian space of dimension greater than three is conformally flat if and only if its curvature tensor R_{hijk} is of the form $R_{hijk} = g_{hj} H_{ik} - g_{hk} H_{ij} + g_{ik} H_{hj} - g_{ij} H_{hk}$ where g_{ij} is the fundamental tensor of the space and H_{ij} is a symmetric tensor. The present paper deals with a type of conformally flat Riemannian space V_n ($n > 3$) for which the rank of the matrix (H_{ij}) is n . The question whether such a space can be a K^* space or a recurrent space of second order has been answered and a necessary and sufficient condition for such a space to be symmetric in the sense of Cartan has been obtained in terms of the tensor H_{ij} . Further, considering a V_n to be of class one, expression for its second fundamental tensor has been obtained in terms of the tensors g_{ij} and H_{ij} .

Analysis

8. On the Continuous Endomorphisms in the Spaces of Certain Classes of Entire Functions

V. KRISHNAMURTHY, Annamalai Nagar

In this paper, we discuss topologies on particular classes of entire functions and continuous linear transformations of these classes into themselves. Such discussion

leads us to a very natural proof, (probably for the first time) by the methods of Operator Theory in Linear Topological Spaces, of the existence of a solution for the functional equation $\alpha(z+w) - \lambda\alpha(z) = \beta(z)$, where α and β are entire functions of the same order and same type. The case $\lambda = 1$, without the reference to the type of the functions, is the classical theorem of Whittaker (Interpolatory Function Theory, 1935), which was subsequently improved by Scott (Proc. Cambridge Philos. Soc. 31, 1935) to the same case with the mention about the type. In the process we also prove that the space of all entire functions topologised by uniform convergence on compact sets and similar spaces of certain subclasses of entire functions are all Montel spaces (cf. Bourbaki, *Espaces Vectorielles Topologiques*, 1955).

9. On Non-Uniform Differentiability

B. K. LAHIRI, Calcutta.

In this paper we define a point of "Uniform" and "non-uniform" differentiability of a function $f(x)$ where it is assumed that $f(x)$ possesses a finite differential coefficient at every point in its domain of definition. The main result of the paper is embodied in the following theorem.

Theorem. If $f'(x)$ exists in an open interval I of which $a \leq x \leq b$ is a closed sub-interval then the points of discontinuity of $f'(x)$ in $a \leq x \leq b$ are precisely the points of non-uniform differentiability of $f(x)$ in $a \leq x \leq b$.

10. On a Non-measurable Mapping

P. L. GANGULI, Calcutta

Starting with two series $\sum a_n = 1$, $\sum A_n = 1$ satisfying certain prescribed conditions and the Cantor set S on $0 \leq x \leq 1$, two functions $f(x)$ and $g(x)$ are constructed which are steadily increasing and continuous but not absolutely continuous in $0 \leq x \leq 1$. Then it is shown that under the transformation $X = f(x)$, $Y = g(y)$, the product set $S \times S$, which is of Lebesgue plane measure zero, is mapped into a set of positive measure.

11. On the Distance set of the Cantor 'Middle Third' Set

N. C. BOSE MAJUMDAR, Calcutta

In discussing the problem of distance set, Steinhaus and others have, among other things, shown that for any d there is at least one pair of points (x, y) , $x \in C$, $y \in C$, such that $y - x = d$, where C is the Cantor set.

In a paper, published in the latest issue of the Bulletin of the Calcutta Mathematical Society, the author of this paper has attempted to find the power of the aggregate of such pairs (x, y) , as mentioned above, for a particular d . For some values of d , it was possible to find the precise power, whereas in others, it was possible to find only the lower bound of the number of such pairs.

In section II of this paper, we have now succeeded in finding the precise power of the aggregate of such pairs for each value of d . Incidentally, we confirm all the previous results and what was claimed previously as lower-bound is now found to be the precise power in each case.

In section I, here, we give another new theorem and a corollary. In the theorem a necessary and sufficient condition has been found for the unique representation of

d by a pair of Cantor points. The corollary gives a necessary condition which a d must satisfy for its unique representation.

Lastly, in a note, the corresponding theorems for the equation $y+x=d$, have been stated.

12. On the Absolute Summability Factors of Integrals (Kumari) PRAMILA SRIVASTAVA, Allahabad

1. Given the improper Stieltjes integral of $f(x)$ with respect to $\alpha(x)$ in the infinite interval $(0, \infty)$, viz.

$$(i) \quad \int_0^{\infty} f(x) d\alpha(x) = \lim_{R \rightarrow \infty} \int_0^R f(x) d\alpha(x).$$

its (C, k) mean is defined by the equality

$$C_k(\omega) = \int_0^{\omega} \left(1 - \frac{x}{\omega}\right)^k f(x) d\alpha(x), \quad k \geq 0.$$

The integral (i) is said to be bounded $[\underline{C}, k, q]$, if

$$\int_0^{\omega} \left|x \frac{d}{dx} C_k(x)\right|^q dx = o(\omega),$$

as $\omega \rightarrow \infty$, and then we write

$$\int_0^{\infty} f(x) d\alpha(x) = O(1) [\underline{C}, k, q].$$

If

$$\int_0^{\infty} x^{q-1} \left|\frac{d}{dx} C_k(x)\right|^q dx < \infty,$$

we say that the integral (i) is summable $[C, k, q]$ and write

$$\int_0^{\infty} f(x) d\alpha(x) = O(1) [C, k, q]$$

2. In the present paper the following theorems have been proved.

Theorem 1. If $k > 0$, $q \geq 1$ and

$$\int_0^{\infty} d\alpha(x) = O(1) [\underline{C}, k, q],$$

then

$$\int_0^{\infty} \phi(x) d\alpha(x) = O(1) |C, k, q|,$$

where (i) $\phi(t)$ is a continuous function such that

$$(ii) \quad \int_0^{\infty} t^{-1} |\phi(t)|^q dt < \infty$$

and

$$(iii) \quad \int_0^{\infty} t^{[k]+1} |d\phi^{[k]+1}(t)| < \infty.$$

where $[k]$ is the greatest integer less than k ; and when k is not an integer, the additional condition that (iii') $|\phi'(t)|$ is a monotonic non increasing function of t , is also satisfied.

Theorem 2. If $k > 0$ and

$$\int_0^{\infty} d\alpha(x) = O(1) |C, k, q|,$$

then

$$\int_0^{\infty} \phi(x) d\alpha(x) = O(1) |C, k, Q|,$$

$1 \leq Q < q$, where $\phi(t)$ is a continuous function of t such that

$$\int_0^{\infty} t^{-1} |\phi(t)|^{qQ/(q-Q)} dt < \infty,$$

and the conditions (iii) and (iii') of Theorem 1 are satisfied.

13. A Convexity Theorem for Strong Riesz Summability (Kumari) PRAMILA SRIVASTAVA, Allahabad

1. Let $\sum a_n$ be a given infinite series and λ_n a positive monotonic increasing function of n , tending to infinity with n .

For $k > -1$, we write

$$A_{\lambda}^k(\omega) = \sum_{\lambda_n < \omega} (\omega - \lambda_n)^k a_n.$$

The series $\sum a_n$ is said to be summable (R, λ, k) , $k \geq 0$, to the sum s , if

$$\lim_{x \rightarrow \infty} x^{-k} A_{\lambda}^k(x) = s.$$

The series $\sum a_n$ is said to be summable (or bounded) $[R, \lambda, k, q]$, $k > 0$, $kq' > 1$, to the value s , if

$$\int_0^\omega |x^{-(k-1)} A_n^{k-1}(x) - s|^q dx = o(\omega) \text{ (or } O(\omega)),$$

as $\omega \rightarrow \infty$. When $q = 1$, $[R, \lambda, k, q]$ is written simply as $[R, \lambda, k]$.

2. In a recent paper the following theorem has been proved by the present authoress

Theorem A. *If $\sum a_n$ is summable (R, λ, r) for some positive r and is bounded $[R, \lambda, k]$ or some $k > 0$, then it is summable $[R, \lambda, k+s]$ whenever $s > 0$.*

The above includes as a particular case the corresponding theorem for strong Cesaro summability due to Winn (Math. Z. 1933). In the present paper the result of Theorem A has been extended to the case of index $q > 1$. It may be mentioned that this theorem again includes the corresponding convexity theorem for strong Cesàro summability obtained recently by Flett (Quart. J. M., 1959).

14. On the Strong Summability of Lacunary Partial sums of Fourier Series SYED MOHAMMAD MAZHAR, Allahabad

1. Let $f(x) \in L^s(-\tau, \pi)$, $s > 1$ and be periodic with period 2π and let its Fourier series be

$$f(x) \sim \frac{1}{2}a_0 + \sum_{n=1}^{\infty} (a_n \cos nx + b_n \sin nx). \quad (1.1)$$

We write

$$\phi(t) = \frac{f(x+t) + f(x-t) - 2f(x)}{2},$$

and denote the partial sum of order m of the above series by $S_m(x)$.

2. The object of this paper is to prove the following theorem, which generalizes a theorem of Salem (American Jour. Math., 77, (1955) pp. 393-403).

Theorem. *Let $\{n_k\}$ be an increasing sequence of positive integers satisfying the following conditions:*

(i) $n_k = O(kA)$, where A is a fixed constant.

(ii) $\frac{n_{k+1} - n_k}{n_k} > \frac{\varepsilon}{k}$, $\varepsilon > 0$;

(iii) $\frac{n_{k_{\nu}+1}}{n_{k_{\nu}}} < B$, where $\{k_{\nu}\}$ is a lacunary sequence such that $\frac{k_{\nu+1}}{k_{\nu}} \geq R > 1$ and

B is a constant.

Then at any point x where

$$\int_0^\eta |\phi(t)|^s dt = O(\eta), \quad s > 1,$$

and

$$|\phi(t)| dt = o(\eta),$$

we have

$$\sum_{j=1}^k |S_{n_j}(x) - f(x)|^r = o(k), \text{ the exponent } r \text{ being fixed but arbitrarily large.}$$

15. On Summability Factors of Infinite Series

SHRI NIVAS BHATT, Allahabad

Definition. Let s_n denote the n -th partial sum of the series $\sum a_n$. We write

$$R_n = (s_1 + \frac{1}{2}s_2 + \dots + \frac{1}{n}s_n) / \log(n+1).$$

Then the series $\sum a_n$ is said to be summable $[R, \log n, 1]$ if the sequence $\{R_n\}$ is of bounded variation, that is to say, the infinite series

$$\sum |R_n - R_{n+1}|$$

is convergent.

Recently Bhatt (Abstract - Proceedings of Indian Science Congress Association, Madras-1958, Part III (Abstracts), p.2) has proved the following theorem on absolute summability factors for infinite series.

If $\{\lambda_n\}$ is a convex sequence such that $\sum n^{-1} \lambda_n$ is convergent and the series $\sum a_n$ is bounded, then the series $\sum a_n \log n \lambda_n$ is summable $[R, \log n, 1]$.

The object of the present paper is to generalize the above result. Here the author establishes the following theorem.

Theorem. Let $\{\lambda_n\}$ be a convex sequence such that the series $\sum n^{-1} \lambda_n$ is convergent and let K_n denote the $(R, \log n, 1)$ -mean of the sequence $\{\log(n+1)a_n\}$. If

$$|K_n| = O\{\log(n+1)\}^k (C, 1), \quad k \geq 0,$$

then the series $\sum \{\log(n+1)\}^{1-k} \lambda_n a_n$ is summable $[R, \log n, 1]$.

By the help of the above theorem some further results concerning the absolute summability factors of Fourier series are proved.

16. On the Ineffectiveness of Absolute Riesz Summability of Type e^n

T. PATI, Allahabad

1. Let $\sum a_n$ be a given infinite series, and $\{\lambda_n\}$ a positive, monotonic increasing sequence, diverging to infinity. We write

$$A_\lambda(\omega) = A_\lambda^0(\omega) = \sum_{\lambda_n \leq \omega} a_n; \quad A_\lambda^r(\omega) = \sum_{\lambda_n \leq \omega} (\omega - \lambda_n)^r a_n \quad (r > 0).$$

The series $\sum a_n$ is said to be absolutely summable by the Riesz mean of type λ_n and order r , or summable $[R, \lambda_n, r]$, $r \geq 0$, if $A_\lambda^r(\omega)/\omega^r$ is a function of bounded variation over (K, ∞) , where K is some finite positive number. We shall say that $\sum a_n$ is absolutely summable by the discrete Riesz mean of type λ_n and order r , or summable $[R^*, \lambda_n, r]$, $r \geq 0$, if $\{A_\lambda^r(\lambda_{n+1})/\lambda_{n+1}^r\}$ is a sequence of bounded variation. By definition, summability $[R, \lambda_n, 0]$ and $[R^*, \lambda_n, 0]$ are each equivalent to absolute convergence.

2. A method of absolute summability is said to be *ineffective* if whenever a series is absolutely summable by the method, it is absolutely convergent. So far we have the following results.

Theorem A. Summability $|R^*, e^n, 1|$ is ineffective (Mohanty, Proc. London Math. Soc., 1951).

Theorem B. Summability $|R, \lambda_n, 1|$ is ineffective if $\lambda_{n+1}/\lambda_n > q > 1$ (Obrechhoff, Comptes Rendus de l'Académie Bulgare des Sc., 1955).

It follows from either of these two results that $|R, e^n, 1|$ is an ineffective method. The author shows in the present paper that even summability $|R^*, e^n, 2|$ is ineffective, and therefore *a fortiori* summability $|R, e^n, 2|$ is ineffective.

17. A Summability Factor Theorem on the Absolute Riesz Summability of Fourier Series

(GANESH DATTA DIKSHIT, Allahabad)

1.1 Let $\lambda(\omega)$ be continuous, differentiable and monotone in $(0, \infty)$ and tend to infinity as ω tends to infinity. Let Σa_n be a given infinite series. We write

$$R_{\lambda}^k(\omega) = \sum_{n < \omega} \left(1 - \frac{\lambda(n)}{\lambda(\omega)}\right)^k a_n, \quad k \geq 0.$$

The series Σa_n is said to be summable $|R, \lambda, k|$, $k \geq 0$ if $R_{\lambda}^k(\omega) \in BV(h, \infty)$, where h is a finite positive number.

1.2 Let $f(t)$ be a periodic function with period 2π and integrable (L) over $(-\pi, \pi)$. Without any loss of generality we may assume the constant term in the Fourier series of $f(t)$ to be zero, so that

$$\int_{-\pi}^{\pi} f(t) dt = 0$$

and

$$f(t) \sim \Sigma (a_n \cos nt + b_n \sin nt) = \Sigma A_n(t).$$

We use the following notations :-

$$\Phi(t) = \frac{1}{2} \{f(x+t) + f(x-t)\};$$

$$\Phi_{\alpha}(t) = \frac{\alpha}{t^{\alpha}} \int_0^t (t-u)^{\alpha-1} \Phi(u) du \quad \alpha > 0;$$

$$\Phi_0(t) = \Phi(t);$$

$$e(n) = \exp(\log n)^{1+\beta} \quad \beta \geq 0.$$

2. The object of the present paper is to prove the following theorem.

Theorem. If $\alpha \geq 0$, $\beta \geq 0$ and $\Phi_{\alpha}(t) \{ \log \frac{K}{t} \}^{\alpha\beta} \in BV(0, \pi)$, $K \geq \pi$, then the series $\sum_{n=2}^{\infty} A_n(x) / (\log n)^{\delta}$ is summable $|R, e(\omega), \alpha|$ where $\delta > 1 + \alpha\beta$, and also in the case $\beta > 1$, $0 < \alpha < (\beta-1)/\beta$, $\delta \geq \beta$.

By virtue of a well-known theorem of Hyslop (Proc. Edinburgh Math. Soc. (2), 5(1936), 46-54) theorems on summability factors proved by Cheng (Duke Math. J. 15(1948), 29-36) and Sunouchi (Kodai Math. Semi. Rep., 1(1954), 59-62) can be deduced from the above theorem.

Fluid Dynamics**18. Constant Shear Flow Past Two Circular Cylinders****L. N. NIGAM, Kharagpur**

Constant shear flow past two circular cylinders is studied using orthogonal curvilinear bi-polar co-ordinates. Cases, when the flow is perpendicular to the line of centres and parallel to it, are worked out. Forces on the cylinders are calculated and the variation of the stagnation points with the dimensionless number $N = \frac{U}{\omega c}$ is studied.

19. Vibration**S. C. CHAKRABORTY, Calcutta**

Vibration damping is of maximum effect in curing resonant vibration where the rate of energy supply exciting vibration is relatively small. The damping forces may be due to sliding friction, Fluid, Impact and Solid.

The differential equation :

$$W/g \ddot{x} + c\dot{x} + Kx = 0, \quad c\dot{x} = \text{resisting force of the moving body.}$$

$$e^{-nt} \left[(x_0/q) \sin qt + x_0 (\cos qt) + \left(\frac{n}{q} \right) \sin qt \right]$$

Damped vibratory motion's period.

$$T = \frac{2\pi}{q} = 2\pi / \sqrt{\omega_n^2 - n^2}$$

The altitude of vibration gradually decreases after every cycle due to the factor e^{-nt} in the ratio $e^{-nt} : 1$ and is used in determination of co-efficient of damping.

Vibration consists two parts--

(i) Free damped vibration

(ii) Forced vibration.

Forced vibration is effective and $X = A \sin (\omega t + \alpha)$

$$\text{Amplitude } A = (Q/K) (1/\sqrt{\left(1 - \frac{\omega^2}{\omega_n^2}\right)^2 + C^2\omega^2/K^2})$$

R.H.S. = deflection; Calculated statically.

$$\text{Phase } \tan \alpha = C\omega/K \left(1 - \frac{\omega^2}{\omega_n^2}\right) \text{ (due to the dynamical condition)}$$

When Periodical disturbing force $Q \sin \omega t$ acting on the vibrating body—

Differential equation :

$$\frac{W}{g} \ddot{x} + C\dot{x} + Kx = Q \sin \omega t.$$

Elasticity**20. Hypo-elastic Strain in Solid Rotating Shaft II.****P. D. S. VERMA, Kharagpur**

A fresh analysis for stresses in a steadily rotating solid shaft of incompressible hypo-elastic material has been made without omitting acceleratory terms in the equations of motion. The improvement lies in finding out two more shearing stresses that were zero in the foregoing treatments of the problem.

21. On the Stresses in a Twisted Composite Sphere**S. B. DUTTA Calcutta**

In this paper stresses have been calculated in the case of a twisted composite sphere. The core of the sphere has been taken to be isotropic and the rigidity of the medium outside the sphere to vary linearly with radius. An expression for the maximum stress on the surface of separation of the two medii has also been deduced.

22. On the Stresses due to a Nucleus in the form of a centre of Rotation in an infinite Elastic Solid with Spherical Inclusion.**P. P. CHATTARJI and S. B. DUTT, Calcutta**

In this paper stresses in an infinite elastic solid due to a nucleus in the form of a centre of rotation at a finite distance from a spherical inclusion have been studied. To begin with a general solution has been obtained with an elastic inclusion and hence particular cases of rigid inclusion and cavity have been discussed. Numerical values for the stress on the surface of the inclusion have been obtained.

23. Axisymmetrical Thermal Stresses in Transversely Isotropic Bodies**AVTAR SINGH, Kharagpur**

A stress function approach for the solution of the axisymmetrical steady-state thermo-elastic problem for the transversely isotropic material, in the presence of body forces, is presented in this paper. It is shown that all the components of the stress tensor and of the displacement vector are expressible in terms of either of the two pairs of stress functions, and certain constants which satisfy quadratic equations involving elastic constants.

24. On the Application of Cagniard's Method to dynamical Problems of Elasticity.**M. MITRA, JADAVPUR**

In this paper, a method (based on the use of Laplace and Fourier transforms and on Cagniard's method of inverting Laplace transforms) is given for calculating the surface displacement due to the application of time-dependent body forces in a semi-infinite isotropic elastic medium. The method is used to determine surface displacement for four different types of applied body forces.

Mathematical Physics**25. Action Principle and Lagrangian with higher order Derivatives**

S. P. MISRA, Cuttack

We have obtained here certain commutation relations of field quantities (field operators and their derivatives) for space-like separation of the points when the Lagrangian density contains derivatives of field operators of order higher than first by using Schwinger's operator principle of Stationary Action. The commutators thus obtained are quite complicated, and the consistency of this procedure can only be discussed in individual cases.

26. Fourth order Meson Equations

S. P. MISRA, Cuttack

We have here applied Schwinger's Action Principle to the case of a fourth order meson equation proposed by Bhabha and Thirring. The result obtained thus is not new, but the method illustrates with the simplest model the difficulties of applying Action Principle when the Lagrangian contains even the second order derivatives of the field operator, and gives a concrete and complete example of the generalisation of the Action Principle when the Lagrangian contains higher order derivatives as given by the author in a recent paper.

History of Mathematics**27. Great Mathematician of Ancient India**

U. C. BARDHAN, Calcutta

Brahmagupta, an Indian mathematician was born 598 A.D., flourished in Ujjain. G. Sarton says,—he was “one of the greatest scientists of his race and the greatest of his time”. He wrote C.628 Bhrahma—sphuta-siddhanta his famous treatise. The book contains original contributions. Chap. II is devoted to the criticism of earlier writers chiefly Aryabhata ; Chap 12 and 18 treat of mathematics. He had given solutions of determinate and indeterminate equations of the first degree, and given fairly complete study of cyclic quadrilaterals.

$$S = \sqrt{(s-a)(s-b)(s-c)(s-d)}.$$

$$(1) \quad x^2 = (ad+bc)(ac+bd)/ab+cd$$

$$(2) \quad y^2 = (ab+cd)(ac+bd)/(ad+bc)$$

where a, b, c, d, x, y represent the sides and diagonals of such a quadrilateral, s the half of its perimeter, S its surface. If $a^2 + b^2 = c^2$ and $a^2 + d^2 = y^2$, then (3) the quadrilateral (ay, cs, by, ca) is cyclic and its diagonals are at right angles. Proposition (2), is known as Brahmagupta theorem, and proposition (3) “Brahmagupta's Trapezium”, He had given the values of the π , $\sqrt{10}$.

He had given rules to determine the number of permutations of n things taken r at a time with and without repetition, and the number of combinations of n things taken r at a time without repetition.

He had given the volume of the frustum of a pyramid with square bases of sides S_1, S_2 equal to $\frac{1}{3}h(S_1^2 + S_2^2 + S_1S_2)$ where h is the height.

His book *Brahma-sphuta-siddhanta* became famous in India and outside India. This book was translated in Arabic by two Arab scholars.

(Ibrahim At-Fazari and Iyacob Iban Tarik) in the reign of Khalifa Al-Man-Sur. His book *Khanda Khadyka* was translated in Arabic and was called *Arkand*, *Brahma-sphuta-Siddhanta* was named *Sindpind*.

28. History of Indian Astronomy

U. C. BARDHAN, Calcutta

Jai Singh II of Jaipur was born in 1686 A.D. and succeeded to the Ambar territory in 1699. In 1708 he obtained possession of the Province.

He was called Machiavelli of his day. He founded a new Capital Jainagar or Jaipur which in his time became centre of learning. He built fine astronomical observatories at fine cities of Hindustan. He conceived and carried a scheme of scientific research that is still a notable example and his influence still a living one. The observatories he erected are, in the words of his historian, "Monuments that irradiate a dark period of Indian History."

At an early age Jai Singh II showed a predilection for astronomical work. He found the astronomical table in use defective and set himself the task of preparing new ones with this purpose in view. Jai Singh took every means to ensure success. He collected astronomical books and had certain of them translated; he organised a regular staff of workers and sent them to foreign countries. He built a large observatory at Delhi and made careful observations there for seven years with a view to the preparation of a new star catalogue; afterwards he built observatories at Jaipur, Ujjain, Banaras and Mathura.

He possessed a valuable library and was acquainted with the works of his predecessors and contemporaries.

Jai Singh, Jagannath says, was clever in inhibiting new methods with gloves and other instruments. He had made observations of the stars. The instruments proper for an observation are said to be :--

- (1) Nadi Yantra (Sun dial)
- (2) Gola Yantra (Sphere)
- (3) Digamsha Yantra (Azimuth instrument)
- (4) Dakh Shino Digbhatt (Mural quadrant) etc. etc.

Jai Singha's astronomical tables, the *Zij Muhammad Shashi*, is a set of astronomical tables prepared under the direction of Jai Singha and named after Emperor Muhammad Sha. Jai Singh began his work when the European astronomers had arrived. A. R. Keyl says, "Jai Singh refused to follow in the lines of research indicated by European astronomers. Had he done so, his power and his wealth might have enabled him to alter the whole condition of Indian scientific scholarship and instead of his labour ending in death, there might have been established a lasting school of research. That Jai Singh made no new astronomical discoveries is hardly a fair criterion of the value of his work; for, indeed, a great deal of the most is not concerned with discoveries. His avowed object was rectification of the Calendar, the prediction of the eclipses, etc. and so on. Considering the state of the country in which he lived, the political anarchy of his time, the ignorance of his contemporaries and the difficulties in the way of transmission of knowledge, his scheme of astronomical work was a notable one, and his observatories still form monuments of a remarkable personalities".

SECTION OF STATISTICS

PRESIDENT: DR. C. R. RAO, M.A., Ph.D., F.N.I.

Abstracts

PROBABILITY

General

1. An Expression for Student's Integral

J. B. S. HALDANE, Calcutta.

I give an expression for the "tail" of Student's distribution which is analogous to the well known asymptotic expansion for the tail of the normal distribution, and like it, is useful when the probability of exceeding the observed value becomes fairly small. In Student's notation,

$$\int_z^\infty (1+u^2)^{-\frac{1}{2}(n+1)} du = (1+z^2)^{-\frac{1}{2}(n+1)} (nz)^{-1} \left[1 - \frac{1}{(n+2)z^2} + \frac{1 \cdot 3}{(n+2)(n+4)z^4} - \frac{1 \cdot 3 \cdot 5}{(n+2)(n+4)(n+6)z^6} + \dots \right]$$

If $t^2 = nz^2$, the series is

$$1 - \frac{n}{(n+2)t^2} + \frac{3n^2}{(n+2)(n+4)t^4} - \dots$$

The series converges if $t > 1$, and is an asymptotic if $t > 1$. But unless $t > 3$, it is best to condense it in the form

$$1 - \frac{n(n+4)}{(n+2)[(n+4)t^2 + 3n]} \dots$$

The first three terms of this series give three or four figure accuracy even when t^2 is as small as 2. A similar series can be calculated for the variance ratio distribution.

2. On the Evaluation of the Probability Integral of the Multivariate Normal Distribution

S. JOHN, Calcutta

A simple formula has been obtained for the evaluation of the probability integral of the multivariate normal distribution. This formula enables us to calculate the probability integral for distributions of order k when those of order $(k-1)$ are readily available. An example is worked out illustrating the use of the formula.

3. On the Evaluation of the Probability Integral of the Multivariate t -Distribution

S. JOHN, Calcutta

A formula has been obtained for evaluating the probability integral of the multivariate t -distribution. The bivariate case is discussed in detail. Similar methods will give the probability integral in the multivariate case also. Finally, applications to setting simultaneous confidence bounds for regression coefficients and to testing the significance of outlying observations are also considered.

4. Binary Channels without Memory

K. R. PARTHASARATHY, Calcutta

In this paper the capacity of a binary channel without memory is evaluated. By using a stronger form of Chebyshev's inequality (due to Bahadur and Ranga Rao) in Khinchine's proof of Feinstein's fundamental lemma, 2^{nH} distinguishable sequences are constructed for any H less than the capacity of the channel, with probability of error decreasing to zero exponentially. The procedure adopted is valid, under certain general conditions, for a discrete channel without memory and with same alphabets at the input and the output.

5. A Limit Theorem for Densities

R. RANGA RAO and V. S. VARADARAJAN, Calcutta

Let ξ_1, ξ_2, \dots be a sequence of independent random variables with common distribution $F(x)$ and let $E(\xi_1) = 0$, and $E(\xi_1^2) = 1$. Let $p_n(x)$ denote the density of the absolutely continuous component of the distribution of the normed sum $\eta_n = \frac{\xi_1 + \dots + \xi_n}{\sqrt{n}}$. (Convergence of $p_n(x)$ to $\varphi(x)$, where φ is the density of the normal distribution function, with various definitions of convergence, such as uniform, or L_1 , has been investigated by Gnedenko and Prohorov. In this paper we examine conditions under which $p_n(x) \rightarrow \varphi(x)$ almost everywhere. We show that this convergence takes place i.e. $p_n(x) \rightarrow \varphi(x)$ a.e. when the distribution of ξ_1 admits a density. Analogous results for convergence to stable distribution functions and extensions to finite-dimensional Euclidean spaces are also considered.

6. A Note on Distributions in Hilbert Space

R. RANGA RAO and V. S. VARADARAJAN, Calcutta

Let Ω be a sample space and H a Hilbert space of arbitrary dimension. In this paper it is shown that every H -valued random variable is essentially concentrated in a separable subspace. More precisely, given any H -valued random variable X , there exists a H -valued random variable X' such that (a) the range of values of X' is contained in a separable subspace of H and (b) for any bounded linear functional t on H' , $t(X) = t(X')$ almost surely. This result seems to be of interest in view of the fact that the problem of constructing a measure on a metric space which does not have mass concentrated in a separable subset, and which is finite, is still unsolved.

7. A Theorem on Conditional Distributions

J. SETHURAMAN, Calcutta

Let (X_n, Y_n) be a sequence of random variables. It is shown that the sequence of joint distributions of (X_n, Y_n) converges weakly if the sequence of marginal distributions of Y_n converges strongly and the sequence of conditional distributions of X_n given $Y_n = y$ converges weakly for each y . If it is assumed that the marginal distributions of Y_n converge weakly the result still holds, provided that the definition of convergence of conditional distribution is strengthened. Some applications to the asymptotic theory of order statistics are given.

Stochastic Processes

8. A Stochastic Model for Dependent Binomial Events

A. K. BHATTACHARJI, Kharagpur

The paper considers a stochastic model for a series of events each of which can have two results, say success or failure. The events are not independent and the probability of success in any event depends on the number of failures preceding it, the maximum number of failures that can precede a success being m . Dandekar's model for a modified binomial distribution comes out as a special case of this model.

9. The Addition of Random Vectors

J. B. S. HALDANE, Calcutta

Alström's data on the distribution of distances between birth places of parents and children show that these distances diverge greatly from a two-dimensional normal distribution, displacements in orthogonal directions being positively correlated. I consider vectors whose direction is completely random in s dimensions, but whose scalar squares have distributions with given cumulants. Addition formulae are obtained for the cumulants of the distribution of the resultant of n such vectors up to the fifth cumulant of the distribution of the square. Simple functions of these are derived, and called vectorial cumulants. They have, in s dimensions, the additive property of ordinary cumulants in one dimension, and after the first, measure the divergence of the distribution from a χ^2 distribution with s degrees of freedom multiplied by an arbitrary constant. The distribution of the scalar square of the vector sum converges in probability to a distribution of this type subject to conditions comparable with those under which the sum of n one-dimensional random variables converges to a normal distribution.

10. Two Models in Branching Processes

U. G. NADKARNI, New Delhi

In this paper two special cases of branching processes are discussed when q_i 's the probabilities for any unit to generate i units are functions of time. In the first model $q_i = 0$ for all i except $i = 1, 2$. In the second model $q_i = 0$ for $i \neq 0, 1, 2$. As particular cases of interest, under each of the above model the cases discussed are, (i) q_i 's are independent of time, (ii) q_i 's are linear functions of time, and (iii) q_i 's are periodic functions of time.

11. A General Solution of Branching Processes

U. G. NADKARNI, New Delhi

Special cases of the general branching processes with particular restrictions on q_i 's, the probabilities for any unit to generate i units are considered by various authors. In this paper, a general solution for the probability generating function of the number of units at any time t , where q_i 's are independent of time, is given. As special cases of this general solution the cases discussed are (i) $q_2 = 1$, (ii) $q_0 + q_2 = 1$, and (iii) $q_i = (1 - q_1)^{i-1} q_1$, $q_0 = 0$

12. Application of Storage Theory to the Ruin Problem in Insurance Business

N. U. PRABHU, Dharwar

The theory of collective risk deals with the risk business of an insurance company, in which, during a time interval $(0, t)$, (1) the total amount $X(t)$ claimed has a compound Poisson distribution, and (2) the gross risk premium received by the company is λt . The risk reserve is $Z(t) = u + \lambda t - X(t)$, with the initial value $Z(0) = u$; clearly $Z(t)$ is a temporally homogeneous Markov process. Starting with the initial value u , let T be the first subsequent time at which the risk reserve becomes negative (*i.e.* the company gets 'ruined'). The problem of ruin in insurance business is concerned with the distribution of the random variable T ; this distribution has not so far been obtained explicitly except in a few particular cases. In this paper, the whole problem is re-examined, and known results in storage theory are applied to obtain explicit results in the cases of negative and positive processes. The results throw considerable light on the general case of a mixed process.

STATISTICAL METHODS

General

13. Bounded-Risk Estimates for the Multi-normal Mean Vector

SHOUTIR KISHORE CHATTERJEE, Calcutta

In this paper, first a theorem of Lehmann regarding the estimation of a location parameter in the presence of a scale parameter in a univariate distribution is extended to the multivariate case. It is proved that if p variables x_1, x_2, \dots, x_p have a continuous p.d.f. of the form

$$\frac{1}{\sqrt{|\sigma_{ij}|}} f\{\Sigma \sigma^{ij}(x_j - \theta_j)(x_i - \theta_i)\}$$

where $\Theta : (\theta_1, \theta_2, \dots, \theta_p)$ represents the location parameters to be estimated and $(\sigma_{ij}) = (\sigma^{ij})^{-1}$ is an unknown p.d. matrix, and if the loss due to an estimate $T : (T_1, T_2, \dots, T_p)$ is

$$W\{\Theta, T\} = V\{\Sigma a_{ij}(T_i - \theta_i)(T_j - \theta_j)\}$$

where (a_{ij}) is a known p.d. matrix and $v\{u\}$ is monotonic increasing in $0 < u < \infty$, then no estimates for Θ based on a sample of fixed size exist, for which the risk is uniformly bounded.

Next, considering the p -variate normal population with mean vector Θ and dispersion matrix (σ_{ij}) , two two-step sequential procedures are given for obtaining such

estimates of Θ . In the first of these the risk becomes completely free from the parameters Θ and (σ_{ij}) and can be made exactly equal to any previously stipulated value. The procedure is similar to that developed by the author in a earlier paper (*Cal. Stat. Assocn. Bull.*, Vol. 8, p. 121), in connection with a different problem. In the second procedure the risk depends on the nuisance parameters but is always less than that of the first procedure and the cost, as measured by the total number of observations required, is also smaller.

14. Inference of Stein's Type for Regression with Stochastic Predicting Variables

SHOUTIR KISHORE CHATTERJEE, Calcutta

In *Ann. Math. Stat.* (1945), under the general linear regression set-up with non-stochastic predicting variables and normal homoscedastic predicted variables, Stein obtained for the regression parameters, two-sample tests with power free from nuisance parameters and spherical confidence regions with predetermined radius and confidence coefficient. In this paper the case of linear regression is considered for a stochastic predicting variable x (of unknown distribution), the predicted variable y being normal and homoscedastic for fixed x . For the regression parameters in this case, sequential procedures are developed on the basis of which tests with nuisance-parameter-free power and confidence intervals of fixed length can be constructed. Although the case of a single predicting variable is considered here, the results have also been extended to the case of several such variables.

15. On the Method of Maximum Likelihood

V. P. GODAMBE, Calcutta

A general class of problems, where maximum likelihood method of estimation does not yield asymptotically 'best' estimates, is discussed. An alternative method which is superior to the maximum likelihood estimation method is presented. This alternative method is obtained by a slight modification of the maximum likelihood method itself.

16. An Optimum Property of Maximum Likelihood Estimates

V. P. GODAMBE, Calcutta

It is well known that when an unbiased minimum variance estimate, having its variance equal to information limit exists, it is given by the maximum likelihood estimate. In the present paper, a new theory of point estimation is put forward. Another concept of the 'bestness' of an estimate is defined. The optimality of the maximum likelihood equation is established almost unconditionally.

17. A Theorem on Rank of a Matrix Useful in Statistics

C. G. KHATRI, Baroda

In this paper, the following theorem is established: Let $A : m \times n$, $B : n \times p$, $C : p \times q$ be three matrices and let $\text{rank } BC = r$, $\text{rank } AB = s$. Let $P : (n-r) \times (n)$ and $Q : p \times (p-s)$ be of ranks $(n-r)$ and $(p-s)$ respectively such that $PBC = 0$ and

$ABQ = 0$. Then the necessary and sufficient condition that all the rows of PB are linear functions of rows of AB or that all the columns of BQ are linear functions of columns of BC is that

$$\text{rank } B + \text{rank } ABC = r + s.$$

Also the necessary and sufficient condition that independent row vectors of PB and those of AB form a set of independent row vectors is that $\text{rank } ABC = s$, while the necessary and sufficient condition that independent column vectors of BQ and those of BC form a set of independent column vectors is that $\text{rank } ABC = r$. Applications of this theorem in statistics are considered in this paper.

18. The Usefulness of Geometric Mean in Particle Size Studies

S. GURUSWAMY and V. S. NARASIMHACHAR, Dhanbad

The geometric mean is a parameter which is suitable for the comparison of size frequency distributions that are skewed, e.g. experimental data on the size distribution of small particles with the help of microscope. Its application is further extended in this paper to the comparison of distributions of widely different average sizes by treating the logarithm of ratio of sizes (instead of the logarithm of size) as the variable. Such a treatment makes the geometric mean a dimensionless number. Equations for calculating the dimensionless geometric mean are given and its usefulness is illustrated in the comparison of size distributions of two samples whose ratio of average sizes is more than 100.

19. Non-null Distribution of the Likelihood-ratio in Analysis of Dispersion

J. ROY, Calcutta

In this paper the non-null distribution of Wilks' likelihood-ratio criterion for analysis of dispersion (multivariate analysis of variance) when the expectation-matrix is of unit rank is worked out in a form suitable for numerical evaluation of the power function when the deviation parameter is small and degrees of freedom for error moderately large. An illustrative table of the power function of the analysis of dispersion test at the five percent level of significance is presented for $p = 1, 2, 3, 4$ variates when the degrees of freedom for the hypothesis are $m = 2, 3$ and the degrees of freedom for error are $n = 200$.

20. The Effect of Non-Normality on a Test of Significance for the Standardised Mean

M. SANKARAN, Coimbatore

The well known Student's t -test for the mean μ of a normal population when σ is unknown and the t test for the difference $\mu_1 - \mu_2$ between the mean of two normal populations are applicable to situations where the population mean or means alone are of interest. But there are situations in Industry, Psychology and Biometry where the ratio of the mean to standard deviation is of greater interest than the mean. Construction of tests for hypotheses regarding the ratio μ/σ (hereafter referred to as the standardised mean) along the lines of Neyman and Pearson has been discussed by

Patnaik (1951, 1955) who has shown that uniformly most powerful tests exist for one-sided alternatives and the best test statistic turns out to be $\bar{x}\sqrt{n} - 1/s$, \bar{x} being the sample mean and s^2 being the sample variance. It may also be noted here that the same problem from the sequential analysis point of view has been studied by Rushton (1950).

The object of the present paper is to study the effect of non-normality on the distribution of the t statistic and more precisely on the effect of what is known as the type I error. Though this problem does not present any essentially new difficulties and can, in fact, be treated along the same lines developed for the classical t test, yet it is believed that the present study is worthwhile as it deals vitally with situations in Industry and Biometry where the tests actually relate to the standardised mean rather than the mean alone.

Using Fisher's K statistics (a valuable tool fully exploited by David (1949) in connection with Fisher's z statistic used in analysis of variance) the effect of non-normality on the tail area probabilities, or in Neyman and Pearson's terminology, on the type I error of the statistic has been investigated. The same problem is studied along the lines of Gayen (1949) and Srivastava (1958). The two lines of approach lead to similar conclusions. Preliminary calculations show that the individual as well as the combined effect of skewness and kurtosis on the type I error may be considerable. Finally using the results of Srivastava (1958) necessary correction terms to be applied to normal theory probabilities for some selected cases are derived.

Fractile Graphical Analysis

21. Fractile Graphical Analysis, some Model Sampling Experiments

NIKHILESH BHATTACHARYYA, Calcutta

This technique has been introduced by Professor Mahalanobis for making certain types of comparisons between different bivariate populations. Consider a simple random sample of size n drawn from a bivariate population of x and y . One may rank the x -values in the ascending order and divide the observations into g serially numbered fractile groups, each corresponding to $n' = n/g$ values of x with contiguous ranks. Next calculate the average y for each group, plot these averages against the corresponding group numbers, and join consecutive points by straight lines. The graph thus obtained is called a fractile graph. Suppose now that such graphs (with equal g) are drawn on the same set of axes for two samples from two different populations, and for the two independent, interpenetrating half-samples comprising each sample. One can then compare the two populations group by group or over a number of groups.

Mahalanobis proposed to test the over-all divergence between the two sample graphs by comparing the area between these two graphs with the areas between half-sample graphs within each sample. He made a number of conjectures in this connection, some of which have been verified to be true on the basis of extensive model sampling experiments by drawing observations from known and unknown distributions.

22. Some Limit Theorems in Regression Theory

P. K. BHATTACHARYYA and K. R. PARTHASARATHY, Calcutta

In this paper a method of estimating the regression function of a random variable y on another random variable x which takes values in the interval $[0, 1]$ is proposed and a test for the hypothesis that $\varphi(x)$ is the regression function is given by utilising the

method of fractile graphical analysis. Some limit theorems as to how fast the convergence of the estimate to the true value takes place are proved. The asymptotic distribution of the estimate, when suitably normed, is shown to be of the double exponential type.

23. Applications of Fractile Graphical Analysis to Psychometry: I. Item Analysis

RHEA S. DAS, Calcutta

One problem of item analysis is to identify and quantitatively assess the error involved in the measurement of ability or other attributes by individual items of psychometric tests. For this purpose, the method of fractile graphical analysis developed by Prof. Mahalanobis may be used. Ability is interpreted as test score, x , and the item measurement as percentage of right answers, y . From the population of subjects taking the test, two subsamples are drawn randomly. For each subsample, fractile groups with equal numbers of subjects are formed in terms of increasing values of x . The percentage of right answers, y , is computed for each fractile group of each subsample. This process is repeated for the combined sample formed by pooling the two subsamples. For each subsample and the combined sample, fractile graphs are drawn connecting the y values of the fractile groups placed equidistantly on the x -axis. The area bounded by the fractile graphs of the two subsamples is termed the "error" associated with the combined fractile graph. This graphical measurement may serve as a quantitative index of the degree of error in item measurement. Results suggest that this measure of error is independent of parameters of item difficulty and discrimination.

24. Applications of Fractile Graphical Analysis to Psychometry : II. Reliability

RHEA S. DAS and K. N. SHARMA, Calcutta

Reliability of psychometric tests is generally estimated from data obtained using one of three experimental models : one test administered twice; two alternate forms of the test administered once; and one test administered once. The formulae used to estimate reliability are different for each model; their assumptions and resulting estimates also differ. However, a common feature of the data for the three models is that they may be represented by two variates, x and y . A method which may be appropriate for examining test reliability, which is uniformly applicable to all three experimental models and free from the assumptions underlying usual estimates of reliability, is provided by fractile graphical analysis.

The application of fractile graphical analysis to reliability estimation is illustrated for split-half reliability. The right score on even numbered items of a test is taken as x , and the right score on odd numbered items as y . Two random subsamples are drawn from the test population. For each subsample, fractile or centile groups are formed on x . For each fractile group, the mean y value is obtained. This process is repeated for the combined sample obtained by pooling the two subsamples. To permit comparison of the reliability for different test populations, mean y values are transformed to a scale with an arbitrary mean and standard deviation. Fractile graphs are drawn, connecting the transformed y values for the fractile groups placed equidistantly on the x axis. The area bounded by the fractile graphs of the two subsamples is defined as the "error" associated with the combined sample fractile graph. This measure of error

may be interpreted as an index of test reliability. Some preliminary results suggest that the error so measured is independent of usual estimates of split-half reliability and the standard error of measurement.

25. On the Use of the Fractile Graphical Method for Analysis of Economic Data

P. C. MAHALANOBIS, Calcutta~

This paper gives some examples of the use of a new method, called fractile graphical analysis, for the comparison of economic data relating to the same population over time, or to any two populations in different geographical regions or differing in any other way. This method can be used for any variate which can be ranked, and is based on certain theoretical conjectures. Proofs are available in the asymptotic case for, and results of model sampling experiments have also been found to be in accordance with, some of these conjectures.

This method summarises in an effective way relevant information in situations where the distributions cannot be reduced to a parametric form, and also provides a graphical way of testing differences between groups. Certain other desirable features about the method are brought out in illustrative examples presented in the paper. In these illustrations, the data used are mainly economic, collected in successive rounds of the National Sample Survey over several years; the method, however, has wider applicability, and has also been used with advantage in the analysis of data relating to anthropometric, psychological and sociological investigations.

26. Some Limit Distributions Connected with Fractile Graphical Analysis

J. SETHURAMAN, Calcutta

Fractile Graphical Analysis was first introduced by Prof. Mahalanobis two years ago as a technique for comparing two samples. He defined statistics like the error area, separation etc. In this paper alternative statistics Δ , Γ etc. are defined and their asymptotic distributions are studied. A certain inequality that connects the error area and the statistic Δ enable us to make some statements about the behaviour of the error area.

Large Sample Theory

27. On the Asymptotic Efficiency of Tests and Estimates

R. R. BAHADUR, Calcutta

Let x_1, x_2, \dots be a sequence of independent and identically distributed variables with distribution determined by a real valued parameter θ . For each $n = 1, 2, \dots$ let $T_n = T_n(x_1, x_2, \dots, x_n)$ be a statistic such that the sequence T_n is a consistent estimate of θ . It is shown, under weak regularity conditions on the sample space of a single observation, that the asymptotic effective standard deviation of T_n cannot be less than $[nI(\theta)]^{-1/2}$. The asymptotic effective standard deviation of T_n is defined, roughly speaking, as the solution τ of the equation $P(|T_n - \theta| \geq \varepsilon | \theta) = P(|N| \geq \varepsilon/\tau)$ when n is large and ε is a small positive number, where N denotes a standard normal variable. It is also shown, under stronger regularity conditions, that the asymptotic effective

standard deviation of the maximum likelihood estimate of θ is $[nI(\theta)]^{-1/2}$. These conclusions concerning estimates are derived from certain conclusions concerning the relative efficiency of alternative statistical tests based on large samples.

28. On the Asymptotic Distribution of Cell Frequencies in a Contingency Table with both Marginals Fixed

SUJIT KUMAR MITRA, Calcutta

The usual hypergeometric type distribution that arises in contingency tables with both marginals fixed is considered and it is shown that in any sequence of such distributions, where the individual cell expectations tend to infinity, the cell frequencies are in the limit, distributed in a multivariate normal distribution.

29. Some Properties of the Asymptotic Variance of Quantiles, Midranges and Quasi Ranges

PRANAB KUMAR SEN, Calcutta

Least square estimates of the location and the scale parameters using the ordered observations have been considered by Lloyd, Gupta, Sarhan and others. Here we propose to consider the problem with a single or two quantiles and study their properties.

Further, it has been shown that for any density function $f(x, \theta)$ of the continuous type having an absolute δ th moment for some $\delta > 0$ and continuous first and second order derivatives for all values of x lying in an interval I_ξ of ξ_p 's containing the median $\xi_{0.5}$ as an inner point and $f(x, \theta) > 0$ for all $x \in I_\xi$, the sample median has asymptotically the minimum variance among the class of sample quantiles, if and only if,

$$a) \quad f(x, \theta) \text{ has a maximum at } x = \xi_{0.5}, \quad \text{and}$$

$$b) \quad \left| \frac{\partial^2 f}{\partial x^2} \right|_{\xi_{0.5}} > 0.25[f(\xi_{0.5}, \theta)]^2,$$

while, for other density functions having an extremum at $\xi_{0.5}$, the sample median has asymptotically the maximum variance among the same class. If the density function has no extremum at $x = \xi_{0.5}$ the sample median will have asymptotically neither the minimum nor the maximum variance among the class of sample quantiles.

It is also shown that for any density function of the above type, the sample median (being the central mid-range) will never have asymptotically the minimum variance among the class of all mid-ranges.

SPECIALISED APPLICATIONS

Biometry

30. A Statistical Analysis of the Relationship between Density and Survival Rate of Indian Carp During the First Week of Life

B. C. DÁS, Calcutta

The relationship between density and survival rate was analysed for 10,911 Indian freshwater carp which had been randomly allocated to 24 experimental units one day after hatching. Each unit contained 9 litres of water; environment and food were kept constant throughout the experimental period. Daily counts of the number dead and complete enumeration of the number alive after the experiment gave the density,

or initial number X of the carp and permitted calculation of the survival rate, as per cent survival Y , after one week of life. A hyperbolic equation

$$Y = \frac{1}{.01145 + .00006X}$$

was found to fit the data. The constants in the equation were determined by a least squares solution. A correlation of $+0.9347$ was found between density and survival rate. The fitted relationship accounted for 87.36% of the variance.

31. Bimodal Distribution of the Style Lengths in an Horticultural Plant *Bauhinia acuminata* L.

K. R. DRONAMRAJU, Calcutta.

Styles of 3,427 flowers from five plants of *Bauhinia acuminata* L. were measured between 27th August 1958 and 23rd November, 1958. The style lengths ranged from 2 mm. to 27 mm. All the 5 plants showed a mode at 5 mm. and a mode at 20 mm. No flower had a style of 11 mm. in length; only 26 flowers had style lengths between 8 mm. and 15 mm. 25 of which occurred on 2 plants. The fractions of short styled flowers obtained for the 5 plants were 24.2%, 11.04%, 22.6%, 21.9%, 6.1%. No order has yet been recognized in the position of the two types of flowers on any of the five plants.

The mean lengths of the long styles on the first two plants show a significant rise and later a decrease as the day temperature rose and fell during the season. The periods of flowering of the latter three were insufficient for such comparison.

As the short styled flowers are female sterile such a variation could play some part in the evolution of dioecy.

32. The Biometry of Asymmetry

J. B. S. HALDANE, V. T. KORDE, S. K. ROY and H. SPURWAY, Calcutta

When some of a group of organisms (e.g. cows) or organs (e.g. leaves) are asymmetrical, we may ask several questions. Is there significant laterality? That is to say, some structure more frequent or larger on the right side than the left, conversely? What is the correlation between the two sides? This is probably the best measure of overall asymmetry when there is no significant laterality. In our data the highest correlation found is $+0.95$, and the lowest, though positive, does not differ significantly from zero. Negative correlation must however occur, for example in crustacea where one or other chela (pair of gripping claws) is very large, and in fish with asymmetrical genitalia. There is no obvious relation between the correlation and the biological advantage of asymmetry, the highest values being for veins on the two sides of leaves, and 'pearls' on the two sides of caterpillars, where asymmetry would be harmless, while a much lower value is found for the attachment of the sacrum to the vertebral column in mice, where asymmetry may be undesirable. Among the questions to be answered are whether different populations of a species differ significantly in their asymmetry, whether asymmetries in different parts of the same organism are correlated, and to what extent asymmetry is inherited. It is certainly inherited in one sense, because if an

organ is present or absent in about half a population, then for a given right-left correlation there will be more asymmetrical structures than if it is present in most or in a few only. But it is not yet clear whether the correlation itself is genetically determined. These and other questions demand a great deal of biometrical research, which can be done as well in India as anywhere else.

33. Asymmetry in the Caterpillars of *Antheraea Mylitta*

J. B. S. HALDANE, Calcutta

Spurway, Kumar, and Dronamraju have examined 532 caterpillars of the tasar silk moth *Antheraea mylitta*. These animals may have a so-called pearl on either side on each of 6 segments. (5 to 10). This may be large, small, or absent. Classifying pearls as present or absent there are 4096 possible classes, of which 3 of the 64 symmetrical ones, with all 12 pearls, none, or the anterior four, are the commonest. 23.7 percent of the animals were asymmetrical on at least one segment, and 5.08 percent of the segments were asymmetrical. Multiple asymmetry was much commoner than would be predicted by a binomial distribution. There was no significant excess of pearls on the right or left side. Altogether 61.7 percent of the possible pearls were present, but on segment 5 this figure rose to 88.5 percent with only 2.26 percent asymmetrical, whereas on segment 7 it fell to 42.3 percent, with 7.14 percent asymmetrical. However the correlations between right and left sides were between $+.85$ and $+.91$ on all six segments. The frequencies of the symmetrical patterns were decidedly different in samples from Jammu and Bihar, and in different families from mated Bihari pairs in the Institute, but the frequencies of various kinds of asymmetry did not differ significantly. It is unlikely that asymmetry is genetically determined.

34. Force of Mortality at All Ages

C. G. KHATRI and B. K. SHAH, Baroda

In this paper, two modifications of Makeham's Curves for graduating Life-Table data, namely,

$$(i) \mu_x = A + B_1 d_1^x + B_2 d_2^x \text{ and}$$

$$(ii) \mu_x = A + H_x + B_1 d_1^x + B_2 d_2^x$$

are considered and methods of fitting them by the method of Hartley by Internal least squares with weighting coefficients are developed. One of the methods, when applied to the graduated data of Makeham at lower age-levels, gives a much better fit.

35. Factors Affecting Blood Pressure of Indian Soldiers

N. T. MATHEW, New Delhi

This paper gives the results of analysis of blood pressure measurements on 2562 soldiers surveyed in 1952-53.

The average blood pressures are 105.1 mm systolic and 55.5 mm diastolic. The variation in individual soldiers is from 75 to 154 systolic and from 30 to 94 diastolic, the standard deviations being 11.3 for systolic and 10.4 for diastolic. There are significant variations among ages, home states, and communities.

The average values are much lower than the standards used by medical practitioners. This is especially true of diastolic pressure. The reasons for these differences may be either techniques of measurement or perhaps something in army life which is conducive to low blood pressure.

Indian blood pressure is lower than that of Americans and Chinese. The blood pressure of UP Muslims may possibly be among the lowest in the world.

Blood pressure measured on the right arm appears to be significantly greater than that on the left arm.

There is no correlation between blood pressure and height. The correlation between blood pressure and weight is of the order of 0.1.

Non-vegetarians appear to have lower blood pressure than vegetarians.

Perhaps the most interesting result presented in this paper is the geographical distribution of high and low blood pressure. In the south of India there is a solid block of comparatively low blood pressure regions and in the north the blood pressure is generally higher. It will be interesting to investigate whether this is due to dietary, racial or climatic reasons.

36. Geographical Variation of Human Stature in India

N. T. MATHEW, New Delhi

From a study of the stature of nearly 140,000 persons who volunteered for recruitment in the army over a period of years, it is found that certain remarkable patterns exist in the variation in average stature from district to district. The Indo-Gangetic plain is generally a region of high stature except for hilly tracts. The coastal districts on the east coast are also above average in stature. The Central, Southern as well as Western districts generally have low stature.

The pattern of variation appears to be consistent with a theory that the original inhabitants of India who were of low stature, were pushed into the Southern half of India as well as into the hilly tracts of the North by tall statured invaders from the North West. Natural selection may also have contributed towards the lower stature in the hills, as shorter persons may have some advantages in the life on the hills.

37. The Statistical Analysis of the Medical Examination Reports of Lady Students of Maharani's College, Mysore

V. NAGARATHNA, Mysore

An analysis of the results of medical examination of University students will be of considerable importance not only to the administration but also to the students and parents as well. The University of Mysore arranged for the yearly medical examination of its students from the year 1924-25. The statistical analysis of the data relating to the years 1924-25 to 1926-27, in the case of boys, was undertaken by Professor K. B. Madhava.

Smt. K. N. Kamalamma made a study of the results of medical examination relating to girl students taking the data from the medical examination reports of 441 girl students of the Mysore University pertaining to the years 1928-29 to 1936-37.

The present work deals with the analysis of the data relating to girl students of the Maharani's College, Mysore for the year 1956-57. A comparative study of the characteristics of lady students of 1956-57 with those of the students for the period 1928-29 to 1936-37 taken from Smt. Kamalamma's paper has also been made in this paper.

The analysis now made has revealed that 86% of the girls of 1956-57 batches were between the ages 17 and 20 years, while the mean age of girls of 1928-37 batch which was 19.11, fell to 18.69 for the 1956-57 batch. But in the case of weight, the girls of 1956-57 were 5.12 lbs poorer than the 1928-37 girls indicating some deterioration in the body build. In respect of chest measurements however no difference between the two batches has been observed. The number of girls with "body defective" was 43 out of 200 in the 1956-57 batch, while it was 251 out of 441 in the 1928-37 batch. The percentage of girls suffering from diseases for the 1928-37 and 1956-57 batches works out to 34.21 and 11.51 respectively. Hence it can safely be concluded that though the girls of the present batch are poorer in physical characteristics, they are much healthier than the girls of 1928-37 batch.

38. Asymmetry in Nipples of Cattle, Buffalos, and Goats, and in Leaves

S. K. Roy, Calcutta

I counted the nipples on 1236 cattle, 300 buffalos, and 579 goats. The numbers ranged from 3 to 8 in cattle, and 3 to 6 in buffalos, with a strong mode at 4. In goats they ranged from 2 to 6, with a strong mode at 2. 52 of the goats had more nipples on the left side, 16 on the right side, a very significant difference. In cattle and goats no significant difference was found. The nipple number was higher in cows than bulls, and in a breed of high milk yield than one of lower yield. The correlations between nipple numbers on the two sides do not exceed $\pm .26$.

I counted the veins on the two sides of 327 leaves of *Bauhinia purpurea*. The number varied from 4 to 8. There was no significant excess on either side, and the correlation between vein number on the two sides was $\pm .95$.

39. Variation in Organs on the Same Plant

S. K. Roy, Calcutta

I counted petals on 158926 flowers of 17 trees of *Nyctanthes arbor-tristis* and 23,127 flowers of 4 bushes of *Jasminum pubescens*, and teeth on 4075 leaves of 7 trees of *Nyctanthes*. The petal numbers on a given tree not merely had a characteristic mean but a characteristic variance. Both were much the same for a given tree in successive years. On several trees the mean petal number altered little during a flowering season, but in *Nyctanthes* the variance increased steadily, while in *Jasminum* it rose to a maximum and then fell again. In biological terms this can be described as a progressive deterioration of organic regulation, or canalization.

The leaves on 4 trees showed a *J* shaped distribution of tooth number, most leaves having no teeth. The other 3 trees had a bimodal distribution, with modes at zero and 6, 9, and 11 teeth respectively.

Psychometry

40. On Discriminating Curves

ASITPRAKASH BASU, Calcutta

Discriminating index and discriminating curve were defined by P. K. Bose (1958) in connection with item selection techniques. In this paper those concepts have been

further developed and used in determining the relationship with the difficulty values. 'Discriminating charts' are expected to provide an indirect method of assessing whether two tests are parallel or not.

41. Statistical Problems in Item Analysis

S. DAS GUPTA, Calcutta

This report is concerned with the application of statistical techniques in the problems of decision-making and designing the items in a test of a single ability. The previous works on this topic are briefly reviewed. The problem of defining the discriminating index of an item is attacked from a new angle. It is further stated that the maximum likelihood approach of estimating the parameters of the items and the unknown abilities of the examinees should be reinvestigated to study the different properties of these estimates. This is due to the fact that the set of responses to the item by a group of examinees may not provide consistent estimates of the parameters involved. This line of approach was initiated first by Neyman & Scott. It is proved that for non-equivalent type of items, logistic-model only provides the sufficient statistic for the unknown ability. Assuming normal ogive model as the item characteristic curve, different properties of the total test score are studied.

This report gives only a number of specific problems in item analysis. In future work, the theory of inference in the problem of selection and classification of individuals will be communicated in detail.

42. A Study on the Selection Procedure for a Certain Course of Study

B. DAS GUPTA & M. K. GUPTA, Calcutta

Selection of the candidates for the different courses of study in our educational institutions is generally based on the results of the candidates in their previous public examinations. The selection is generally quite arbitrary and based on certain pre-conceived notions, which may be found to be quite wrong under careful study.

Such a study is reported in this paper. Relative predicting power of different Intermediate subjects in the selection of candidates for admission into the B.Sc. class of a certain institution with honours in a particular subject has been studied. Also a discriminant function has been obtained which will discriminate best between the two groups of selected students, viz., those who pass with honours (first or second class) and the rest. The current method of selection is critically examined in the light of the present study.

43. Factor Analysis by the Method of Orthogonalization

N. K. GUPTA, Calcutta

A battery of n tests applied to N persons gives rise to a score matrix of order $n \times N$. In factor analysis we describe these variables by a smaller number of factors. This is accomplished by analysing the matrix of inter-correlations. In the present paper it is shown how starting from the normalized score matrix we can first get the population matrix and then the factor matrix. By the method of orthogonalization we obtain the population matrix, the rows of which form the basis of the vector space generated by the row vectors of the normalized score matrix, that is, by the test vectors. Then the loading of the j -th test with the k -th factor is the scalar product of the j -th test vector and

the k -th factor vector. Again if m be the rank of the score matrix, i.e. the number of rows of the population matrix, then m of the n rows of factor matrix are obtained without any further calculation. We got these while calculating the factors and $m(m-1)/2$ of the elements of the factor matrix will be always zero. In this case we get a set of orthogonal factors.

44. Verification of Guilford's Generalised Psychophysical Law

AMAL KUMAR MALLICK, Calcutta

Guilford's generalised Psycho-physical Law in the form of the n -th power function includes the classical Psycho-physical Law of Weber and Fullerton-Cattell's Square Root Law, as simplified and special cases. It is analogous to, and inclusive of, Woodworth's formula that harmonises and also includes the latter two Laws. Each of the above Laws other than Guilford's has been applied to the data obtained in an experiment conducted by the author in which half-length judgements of subjects have been taken. Wide discrepancies between the experimental observations and the Laws have been noticed. This is inexplicable on the ground of mere chance. There must be something wrong in these three Laws which fail to conform to the data. Hence they do not hold good at least in this case.

Attempt has been made to explain the data in the light of Guilford's n -th power function. It has been found that this has met with success. The difference between theory and fact is very narrow, and this narrow difference may be ascribed to chance. So the data are found to be consistent with Guilford's Law rather than with Weber's Law, Fullerton-Cattell's Law or Woodworth's Law.

Thus the generality of Guilford's n -th power function has been established.

Econometrics

45. On a Method of Computing Engel Elasticities from Concentration Curves

N. SREENIVASA IYENGAR, Calcutta

This paper presents, on the assumption of lognormality, a simple graphical method of deriving the Engel elasticities for various items of consumer expenditure from what are known as concentration curves. Usually two types of such curves are distinguished: (a) the Lorenz curve which relates the proportions of total expenditure to the proportions of persons spending up to a given level of total expenditure per capita and (b) the specific concentration curve which is defined as the proportions of total consumption of the specific commodity by proportions of persons spending up to a given level of total expenditure per capita. The author briefly indicates a method of using these curves in the calculation of the Engel elasticities and gives some numerical results for a few important items of consumer expenditure. Finally those are compared with the estimates obtained by the conventional method of least squares on the assumption of constant elasticity.

46. Linear Programming Techniques applied in Tariff Policy

G. S. MADDALA and P. S. R. SAMBASIVA RAO, Bombay

Linear Programming has been till now widely used in transportation problems, resource allocation problems and spatial equilibrium analysis. The present paper

considers the application of linear programming in tariff policy. The solution turns out to be a slight modification of spatial equilibrium models. A tariff and an export subsidy can be viewed respectively as increasing and decreasing the transport rate. Hence the solutions of the spatial equilibrium model before and after imposition of tariff or grant or export subsidies (which are assumed here to be specific and not ad-valorem) can be compared to assess the effect of the tariff. The method is illustrated by means of a six-country single-commodity model. All the problems arising from the balancing of trade, exchange-controls, variations in exchange-rates, interactions between the markets of inter-related goods etc., have been assumed away in order to focus attention on the main method of analysis.

47. An Analysis of the Distribution of Personal Income in Mysore City V. NAQARATHNA, Mysore

An analysis of the distribution of personal income of the people of Mysore city as compared with the distribution of the personal income of the members of the families of the University students in Mysore city has been undertaken in this study. The data for this comparative study have been taken from the following two sample surveys :

(i) The demand for products of cottage and small scale industries in Mysore city (1955).

(ii) The living conditions of the University Students in Mysore city (1957).

The average of incomes of these two classes are compared with the National (All-India) average for the respective years, and with each other making allowance for the different years.

As these two surveys contain low income ranges, the comparative degrees of inequality cannot be measured by the "Pareto's Constant" as "Pareto's Law" cannot be extended to lower incomes.

It is found that Gini's formula also could not be applied in this present comparative study, where lower income levels are included. We may agree with Bowman when he observes that "despite the fact that the Gini formula gives a better description of the model range of the income distribution than is provided by the Pareto Formula it must still be recognised as the emphasis is on the behaviour of the income distributions in the upper rather than the lower income levels".

In the present study of comparison, "Lorenz Curve" which is a simple graphical device most commonly used to indicate the difference in the degree of inequality of different income distributions has been applied and a marked inequality has actually been noticed in both the cases, the inequality in the case of distribution of personal incomes of family members of the University students being more. The existence of this inequality in the latter case has been confirmed by working out the several measures of inequalities suggested by Yntema.

48. Linear Programming versus Non-Linear Programming in Indian Economic Studies

M. VAIDYANATHAN, Hyderabad

This paper discusses the basic concepts of linear and non-linear programming, marginal productivity and Leontief systems, and considers the applications of these concepts to (1) production in textile industry; (2) cost and price relations with reference to labour problems; and (3) capital formation and welfare economics.

The principle of mathematical dual, fixing an optimum for the Simplex method in linear programming, and formulae for non-linear programming involving time factor, have been worked out.

Design of Experiments

49. Fractional Replicates as Asymmetrical Factorial Designs

M. N. DAS, New Delhi

A method of constructing confounded factorial designs from fractional replicates of symmetrical confounded designs has been described. Through this technique any type of such designs including all the existing asymmetrical factorial designs can be obtained. Nature of confounding as also the conditions for balance in such designs have also been investigated.

50. A Uniformity Trial on Clonal Tea in Assam

A. R. SEN, Cinnamara

It is proposed to present in this paper some of the results of a preliminary investigation into plot technique studies conducted on uniformity data for one year on clonal tea which was hedge planted (5' x 2') on flat land in an Assam tea estate during 1952. The basic data were taken on 6 bushes unit and covered 240 units with no guard rows.

The coefficient of variability decreased with increased plot size and long and narrow plots were more efficient than more compact ones. Similar results were obtained on tea by Eden in Ceylon and Laycock in Nyasaland. Increasing the plot size beyond 60 bushes did not bring about any appreciable reduction in error. Efficiencies were worked for the Latin square design with respect to the R.B.D. and of the latter with respect to the C.R.D. in terms of saving in replications.

51. On Certain Optimality Criteria for Incomplete Block Designs

K. R. SHAH, Dehra Dun

Several optimality criteria have been suggested by various authors to measure the efficiency of designs. To minimise the average variance of elementary treatment comparisons we minimise $\sum \lambda_i^{-1}$ where λ_i 's are the non-zero roots of 'C' matrix. As suggested by Wald we can maximise the minimum power of the usual *F* test by maximising λ_{min} . Wald also suggests the minimisation of $\pi \lambda_i^{-1}$. Three efficiency criteria corresponding to the above three problems are framed.

It has been proved by various authors that for given (*v*, *k*, *b*, *r*) if a *BIB* design exists it is the most efficient. It can be seen that judged by any of the three criteria given above, given block size *k* and the number of treatments all balanced designs give the same optimum efficiency. (at least one balanced design always exists)

The above three criteria are based upon different considerations. They are all connected with the dispersion of λ 's. In each case optimality is reached when λ 's are all equal. This suggests the use of $E_4 = \frac{(v-1)^{-3/2} (\sum \lambda_i)^2}{R \sqrt{\sum \lambda_i^3}}$ as an efficiency criterion.

where $R = \frac{\sum r_i}{v}$. With each of the above criteria, $E = \frac{1-1/k}{1-1/v}$ for a balanced design

and with increasing k , E approaches unity. The criterion E_4 does not possess any concrete interpretation, but is closely related to the above three. Furthermore

$$\sum \lambda_i = \text{Trace } C \text{ and } \sum \lambda_i^2 = \text{Trace } C^2 = \sum_i \sum_j C_{ij}^2$$

Hence E_4 can be calculated directly from the 'C' matrix without going to the roots of 'C'. It is suggested that E_4 would be a workable measure of overall efficiency of a design and may be of use because of its simplicity.

Sample Survey Techniques

52. On Statistical Controls in Surveys

K. G. BASAVARAJAPPA and K. V. RAMACHANDRAN, Bombay

In any sample survey, errors in the estimates we are interested in, occur through several major causes. One of the causes of error is due to sampling itself and this error can technically be made less if the sample size is increased indefinitely.

There are several major sources of error in surveys and they could be due to mistakes in the questionnaires and methods of canvassing, non-response and wrong response, missing of units to be sampled, measuring wrong units, errors in measurement, bias in measurement, investigation biases and those at the stage of analysis of the data. Methods for controlling some of these errors are already available.

Investigator biases could enter into a survey due to gross negligence, pure guess work, consultation with each other and dishonestly cooking up of data by unreliable investigators and also due to difficulties encountered in enumeration.

Mahalanobis has suggested certain methods of detecting and controlling these biases.

This paper deals with the derivation of the Mahalanobis procedure by using the well known Roy Union-Intersection principle and studying the operating characteristics of the procedure. A generalisation of the Mahalanobis procedure is indicated.

53. An Admissible Estimate for any Sampling Design

V. P. GODAMBE, Calcutta

If for any sampling design $P(\lambda)$, $\lambda = 1, \dots, N$, denote the probability of the individual λ being included in a sample, then it is proved in the paper that the usual estimate

$$e_s = \sum_{\lambda \in s} X_\lambda / P(\lambda),$$

(X_λ being the variate value of individual λ and \sum standing for summation over distinct $\lambda \in s$

individuals in the sample s) is admissible in the whole class of unbiased estimates of the population total.

54. A Best Unbiased Estimate of the Population Mean in Cluster Sampling when the Clusters are of Unequal Size

M. V. JAMBUNATHAN, Mysore

Under a sampling plan which employs cluster sampling, the clusters being of unequal size, the population mean \bar{x} is usually estimated by $\sum p_i \bar{x}_i / \sum p_i$, where p_i is the

size of the i -th cluster and \bar{x}_i is the mean of the i -th cluster. This estimate is known to be a biased one, though the bias generally tends to zero as the sample size increases. Assuming a suitable mathematical model, a method of estimation is suggested in this paper which yields an unbiased estimate of the population mean, which is also the maximum likelihood estimate and having therefore minimum variance. This estimate is the weighted average of the means of the sample clusters, that is

$$\bar{x}' = \Sigma w_i \bar{x}_i / \Sigma w_i,$$

where $w_i = p_i / \{1 + (p_i - 1)\rho\}$, and ρ is the intra-class correlation coefficient. The minimum variance, (which is the same as the variance of the above estimate) is obtained as $\sigma^2 / \Sigma w_i$, the quantity σ^2 being the population variance.

The method adopted here yields certain other useful results, such as the statistic for an unbiased estimate of the population variance σ^2 , and the distribution of r , the intra-class correlation in the sample, both under the null and the non-null hypotheses.

55. Use of Sampling Methods in Estimating the Utilization of Clerical Man-hours in Offices

N. T. MATHEW, New Delhi

The method of 'Snap Readings' employed in Statistical Quality Control has been adapted to determine the proportion of time devoted to assigned duties, incidental duties, personal needs, idle time, etc in a typical office. It is likely that this approach will be useful in assessing staff requirements in large clerical establishments.

56. Randomised Rounded-off Multipliers in Sampling Theory

M. N. MURTHY and V. K. SETHI, Calcutta

In large scale sample surveys the work at the tabulation stage becomes difficult, cumbersome and time-consuming because of the large number of multipliers (weights to be given to the sample units for getting the estimate) involved, when a non-self-weighting design has been adopted at field stage. An attempt is made to find a method of substituting the actual multipliers by a smaller number of multipliers which may be called rounded-off multipliers. The method of selection of these rounded-off multipliers so as to minimise the increase in the variance of the estimate and the method of allocation of these to the actual multipliers so as to retain the character of unbiasedness of the estimate have been discussed. The problem of minimising the increase in the variance by a proper splitting up of the large multipliers is also considered. Further a practical method has been suggested to decide the number of rounded-off multipliers to be taken so as to get a desired precision.

57. A Note on Probability Sampling

M. N. MURTHY, Calcutta

Given π_i , ($i = 1, 2, \dots, N$) the probability of inclusion of the i th unit in a sample of size n a simple procedure of selection of the sample would be to take a systematic sample of n units with probability proportional to π_i 's with 1 as the sampling interval and with a random start from 0 to 1. The estimator based on such a sample can

be considerably improved by arranging the units in some suitable order, before selection. In fact, arrangement in increasing order of $\frac{x_i}{\pi_i}$, where x_i is the value of an auxiliary variate, is likely to be very efficient.

58. Studies on Different Methods of Selecting Plots within a Village for Estimating Crop Acreage

N. S. NANJAMMA, Calcutta

Methods for selection of clusters of plots of different sizes were examined for various sampling designs.

It was observed that the variance of the estimate increases with increase in the cluster size at different rates for the different methods tried. For clusters of size 1 (sampling individual plots) systematic selection with probability proportional to area was found to be far better than the other methods. With increase in the cluster size, the estimates for selecting with probability proportional to area (with replacement or systematically) were found to become less efficient very rapidly, whereas for the other methods tried out, the rate of decrease in efficiency was much slower. For large cluster sizes therefore, it is expected that simple random sampling or systematic sampling would be preferable.

Ratio estimate for simple random sampling and sampling a systematic cluster of plots with probability proportional to total geographical area turned out to be uniformly bad for all the different cluster sizes, the former because the correlation between the geographical area and crop area for aman rice was very poor.

59. Some Sampling Mechanisms

T. V. HANUMANTHA RAO, Calcutta

If a finite population of N units is denoted by $1, \dots, \lambda, \dots, N$, it is sometimes desirable to have a 'sampling design' which gives preassigned probabilities $P(1), \dots, P(\lambda), \dots, P(N)$ of the respective units being included in a sample. For this purpose some 'sampling mechanisms' are put forward in this paper. The superiority of these 'sampling mechanisms' to the earlier known mechanisms is also discussed.

60. An Existence Theorem in Sampling Designs

T. V. HANUMANTHA RAO, Calcutta

A set of units is a population. A sample is defined as a sub-set of this set. An arbitrarily chosen set of samples with corresponding probabilities (which sum up to 1) defines completely a 'sampling design'. Now a 'sampling mechanism' is defined as a rule of drawing units 'one after another' with arbitrarily chosen probabilities. The following theorem is proved in this paper: Every 'sampling design' is obtained as a result of some 'sampling mechanism'.

61. On Some Aspects of Sampling With Varying Probabilities

D. SINGH and K. V. DESIKAN, New Delhi

Selection of sampling units with probability proportional to some measure highly correlated to the character under study improves the efficiency of the estimates consi-

derably. However if more than one character is to be studied from the same unit, choice of selection probability is not easily determinable. This problem for two characters has been studied in this paper. It has been shown that under certain conditions, it is possible to find selection probabilities such that the loss in efficiency in using them as compared to the one when each character is studied separately depends on certain characteristics of the population and the sample size. The conditions under which this loss in efficiency can be minimised have been found.

62. On the Theory of Classical Regression and Double Sampling Estimation

B. D. TIKKIWAL, Dharwar

The author has shown earlier (Proceedings of the Forty-fifth Session of the Indian Science Congress Association 1958, part IV, 7-8) that the classical regression and double sampling estimators are the minimum-variance linear unbiased estimators without any restriction. The variances of the two estimators were calculated for a finite population under the assumption that the regression coefficient occurring in the estimators is a known constant. When the regression coefficient is to be estimated from the sample the variance formulae for the two cases were obtained under the normality assumption. The present paper gives the variance formulae and their sample estimators without any assumptions. It is shown that an estimator, having some desirable property of the variance of the double sampling estimator is $[(n' - n)/nn'] Q/n - 3 + Sy^2 (N - n')n'N$ in the notation of Sukhatme (Sampling Theory of Surveys with Applications).

Statistical Quality Control

63. Use of Counts for Inference About the Probability that a Variable Does not Exceed a given Limit.

A. MATTHAI and J. ROY, Calcutta

Methods of using in an optimum way counts instead of measurements on sampled individuals for estimation or testing of hypotheses regarding the proportion of individuals in the population falling short of a given value, are presented in this paper.

The methods are applicable to the general class of distributions characterised by a location and a scale parameter. The two situations corresponding to the scale parameter being known as well as unknown are considered. In the estimation problem different estimates are proposed and the variances derived and compared. Similarly, different acceptance criteria with optimum properties are suggested. The gain in efficiency in both types of problem is illustrated in the case of normal distribution.

Uses of the techniques in industrial sampling inspection and also in problems in bio-assays are discussed. Tables for 'optimum settings' or limits with reference to which counts will be made, are furnished.

64. Statistical Systems—Their Scope and Potential

S. P. VASWANI, Bombay

The paper describes the results and the scope of systematic applications of the techniques of Statistical Quality Control in Industry, Trade and Administration. These

techniques, when applied properly, have actually helped in obtaining considerable benefits in various fields.

It has, however, been observed that the term Statistical Quality Control fails to convey its real meaning to non-statisticians, for whose benefit the techniques are, in fact, meant to be applied. The general impression is that these techniques are confined to some kind of vague improvement of quality alone and have nothing to do with more efficient and economic working and better planning. It is suggested that with the widening spheres of application in which these techniques are found to be useful day by day, the term Statistical Quality Control should be changed to "Statistical Controls". As more and more systematic applications of these controls gain ground in various fields, it is further suggested that the term may then be replaced by "Statistical Systems in Industry, Trade and Administration".

Scope exists for the application of these techniques in the economic, social and political fields also. It is also intended to extend the benefit of the applications of statistics from man-made organisations to living organisms, and, yet higher, from living organisms to man himself as he is, and, higher still, from man as he is to man as he should be in keeping with the universal spirit of man. Then indeed would the ultimate aim of Statistics have reached its final goal.

Miscellaneous

65. Syllable Counts on Modern Bengali Prose

NIKHILESH BHATTACHARYA, Calcutta

From each of sixteen works, two by each of eight authors, 100 lines were selected at random and the number of syllables (x) was determined for each word occurring on these sample lines. The frequency distributions of x were studied with a view to examining how far they can indicate an author's 'style'. The conclusion was largely in the negative, there being significant (and wide) differences between the two works of some of the authors. Such unfortunate results do not seem to have been met with in Western studies.

For five works, systematic samples of lines were taken in various ways. The resulting word-length distributions broadly agreed with those based on randomly selected lines, thus indicating the approximate randomness of the series of word-lengths.

The investigation has thrown up interesting data regarding word-length in terms of syllables, and regarding compositions of words and syllables. The average Bengali word has about 2.3 syllables, of which roughly 67% are 'open' and 33% 'closed'; (closed) syllables with diphthongal vowels are only about 5% of the total. Here again, the p.c. of open (or closed) syllables vary significantly between and within authors.

66. Quantitative Delimitation of Regions

M. N. PAL, Calcutta

An attempt has been made in this paper to review the statistical methods so far applied to delimit regions in the field of "Regional Geography". Discussions are mainly on the limitations of the application of the "chi-square" statistic by Zoblör, the advantage of the application of the concept of "Lorenz curves" by Wright, the

limitations of applicability of "Multiple Factor Analysis" with reference to Hagood's and Prakasa Rao's work, the advantage of the analysis of "spatial co-association" of variables by Hook, Mcarty and Robinson, and the advantage and disadvantage of the use of "distance index" of several variables as suggested by Berry with reference to the delimitation of "homogeneous regions" and also on the little progress which has so far taken place while quantitatively delimiting the "functional or hierarchical region".

SECTION OF PHYSICS

PRESIDENT : Dr. S. Parthasarathy

Abstracts

General Physics

1. Intermolecular Potential of Helium

A. K. BARUA, Calcutta

Potential energy function for He-He interaction has been obtained on the exp. 6-8 model by fitting in second virial and zero-pressure Joule-Thomson coefficient data over an extensive range of temperatures. In addition to the dipole-dipole interaction term in the attractive potential, the dipole-quadrupole interaction term has also been taken into account. The necessary quantum corrections have been considered. Excellent agreement is obtained between the values calculated from the potential energy function determined and the experimental data. On the whole exp. 6-8 potential gives better fit with the second virial and Joule-Thomson coefficient data than either the exp.-6 or the Lennard-Jones (12 : 6) potentials.

2. Solution of Cauchy's Problem for the Scalar Meson Wave Equation in a Curved Space

S. C. MALAVIYA, Lucknow

An earlier method (Malaviya 1958) for the solution of the Cauchy's problem for the scalar meson wave equation in a flat space has been generalised for a curved space.

3. Possible Transformations of Maxwell Equations

MOHAN JAUHARI, Lucknow

The continuous transformations under which the Maxwell equations are invariant are found out. The widest group of such transformations is shown to be the fifteen parameter group of conformal transformations studied earlier (Vachaspati and Jauhari 1959). The laws of transformation of the various field quantities are given explicitly. It is found that the transformation law for the field tensor contains an arbitrary constant which mixes up the electric and magnetic fields. However, this constant does not appear when the vector potential is introduced. The case when external currents are present is also discussed.

4. On Conservation of Matter and Energy in Relativity

R. V. WAGH, Poona

The principle of conservation of energy has been a topic of vital importance in classical dynamics. In relativity matter and energy being as a matter of fact inseparable cannot be considered exclusively. We apply here instead of the differentiation the covariant derivative to the material energy tensor $T^{\mu\nu}$ and write equations of conservation as $(T^{\mu\nu})_{;\nu} = 0$.

A particular case $e\mu = \frac{e\vartheta(t)}{\left[1 + \frac{4r^2}{R_0^2}\right]^2}$ and $e\nu = 1$ is considered and appropriate

relations are obtained for the conservation of matter and energy.

5. Calculation of the Optical Potential

S. MUKHERJEE, Calcutta

Optical potential was calculated from the reaction-matrix formalism of Brueckner including the Hugenholtz correction term of second-order in reaction-matrix. The correction term of Hugenholtz was found to have a profound effect on the detailed structure of the optical potential.

6. The Problem of Polymerisation and the Theory of Numbers

V. S. NANDA and R. K. PATHRIA, Delhi

The number theory approach to the problem of degradation of polymers, developed in a recent series of papers, is employed here to the study of the problem of polymerisation, both of the condensation and of the addition type. In the former case we start with the simplest process of polymerisation and later take up the problems of molecular weight stabilisation and multichain polymerisation. For the addition polymers even the simplest case of linear polymerisation has to be discussed under various headings depending upon the mechanism involved. First we consider the different aspects of one-end termination and then those of the slightly more involved two-end termination. In all the cases considered, expressions are derived for the size distribution and the various averages of interest.

The cases when (i) the growing chains are deactivated through the agency of transfer agents and (ii) two or more agencies of deactivation are simultaneously operative are under investigation.

7. The Problem of Copolymerisation and the Theory of Numbers

R. K. PATHRIA and V. S. NANDA, Delhi

The technique of the generating function employed in our earlier work on polymers is extended to the problem of copolymerisation. Here, because of the variety of monomers present in the polymerising sample, various interesting possibilities arise. Even for the simplest case of two types of monomers, one has to deal with the following three possibilities :

- (i) when two types of monomers *A* and *B* cannot get linked with their own kind; the polymer chains being of the type...*A B A B*
- (ii) when the above restriction holds only for the type *B*, the polymer chains being of the type...*A A B A A A B A B*.
- (iii) when there is no such restriction for the either type, the joining up being completely random.

In all these cases expressions for the size distribution and the various averages are obtained. In the case (iii) above the intra distribution of sequences of the monomers of the same type is also discussed.

The counter part of this problem for the case of addition copolymers is under investigation.

8. Possible Transformations of Wave Equations of Massless Particles of Spin Half. I. Four Component Equation

VACHASPATI, Lucknow

Invariance of the massless Dirac equation under continuous transformations is examined. It is found that the widest group under which the equation is invariant is the relativistic conformal group. Explicit expressions for the transformed wave function and equations are given. The extent to which the charge conjugate solution may mix is determined. The case of the two component equation can be similarly discussed.

Astro Physics

9. The Wholesale Annihilation of Matter.

SHIV KISHORE, Allahabad

The British school of cosmologists have put up the theory of continuous creation of matter throughout the universe in the form of hydrogen. The cosmic coincidence equation $2\pi\rho G\tau^2 = 1$ can be evoked to prove that it is possible as the sum total energy of the universe is zero and the positive energy given by $E = mc^2$ due to inertial mass of matter is the counter part of the negative gravitational potential energy of that body with the rest of universe.

The author has tried to show that wholesale annihilation of matter can take place if the process is reversed. Using the modified equation $2\pi\rho GR^2 = C^2$ and substituting the nuclear density of matter or some still higher density possible as in Chandrasekhar collapse of degenerate collapsed super giant neutron star, the author has tried to show how matter in bulk might get annihilated. The stages in the process of change over from collapse to explosion has been indicated.

Thus the amount of concentration of matter has been determined by using purely the inertial property of matter. The origin of planetary matter and the source of cosmic rays from such supernova explosion has been indicated.

10. The Rotation of small Bodies revolving round their Luminary

SHIVA KISHORE, Allahabad

In this paper it has been shown that it is in the very nature of things that small bodies revolving round their luminary would spin in the proper direction.

On the basis of his "Theory of exploding planets" explained at the Indian Science Congress in 1953 the author was of firm opinion that the meteorites have their origin from "the mother of Asteroids". However, Robertson and Poynting effect which produces a drag on their motion would sweep all such small bodies into the sun in very short time and they should not have survived till now. Yarkovsky effect which depends on evening and morning temperature difference can aid or oppose Robertson-Poynting effect depending on whether the meteorite is rotating in the retrograde or proper direction. Similarly, Whipple had suggested acceleration or retardation of comet motion depending on their direction of spin.

The author was however of the opinion that there is some thing to make the meteorites spin in the proper direction and this having a stabilizing effect on the

meteorite orbit does not let them be swept into the sun. The whole problem was re-examined. Robertson and Poynting had not taken serious notice of the fact that only half of the meteorite is illuminated by the sun. On doing so it is found that the retarding force due to Robertson and Poynting effect does not pass through the centre of mass and lies on the side of the sun. This results in a couple trying to rotate the meteorite in the proper direction. Such a rotation produces forces which oppose Robertson and Poynting effect.

The author has shown that the rotation develops very fast and the rotation required to stabilize the orbit, is produced before the orbit changes appreciably.

11. The Classification of Planets and Satellites

SHIVA KISHORE, Allahabad

The author has classified the planets by the application of nuclear physics in the evolution of planets. The four major heads are (1) Boiling planets, (2) Exploding planets, (3) Giant planets, (4) Dead planets. The density of the inner planets has been explained in light of recent measurements.

The satellites have also been classified : (1) our moon which has its origin from an exploding cum boiling plane, and (2) all the other satellites which have their origin from the mother of asteroids have been explained. The density of the core of planet mars has been explained.

Besides this, the retrogratory spin of Uranus has also been explained.

The general behaviour of the planets has been explained.

12. Light Variation of γ Pegasi.

S. D. SINHA, Naini Tal

The light curves of the β Canis Majoris star γ Pegasi using standard B and V filters are obtained. The epoch and the period of light variation have been freshly determined. The amplitude of the light variation is about $0^m.017$, both in B and V .

13. Period Variation in CY Aquarii

N. B. SANWAL, Naini Tal

A photoelectric study of one of the short period cluster type variables CY Aquarii was made during 1958. Times of seventeen light maxima were obtained for the star. These observations when combined with those of other observers indicate that the period of the star has been decreasing steadily since 1942-43 at the rate of .0023 seconds per year.

14. Photoelectric Study of the Eclipsing Binary System 32 Cygni.

SUBHASH CHANDRA and M. C. PANDE, Naini Tal

A photoelectric investigation of the eclipsing binary 32 Cygni was carried out during the period April 1, 1959 to April 26, 1959. Observations were made through the B and V filters and were transformed into the standard system of Johnson and Morgan. Colour Index of the system varies between 1.54 and 1.64 and amplitude of the light curve is about .03 magnitude. An analysis of the data yields that the primary is of K5-Ib type and secondary is of early BV type. This is in conformity with the earlier spectroscopic studies by E. B. Weston and P. A. Wellmann.

15. The Spectrum of the Shell of Pleione

M. K. VAINU BAPPU and S. S. VARMA, Naini Tal

Coude spectrograms having a dispersion of 2.8 Å/mm and 10 Å/mm in the blue region taken with the 100-inch reflector on Mount Wilson have been measured for radial velocities and absorption-line intensities. The plate material taken from 1943 to 1952 covers most of the period of formation and dissipation of the shell. Equivalent widths of several shell lines of Fe II, V II and Ti II have been used to form curves of growth for the different years. The electron pressures and excitation temperatures obtained are discussed.

16. The Infra-Red Spectra of the Wolf-Rayet Stars of the Carbon and Nitrogen Sequences

M. K. VAINU BAPPU and SUBHASH CHANDRA, Naini Tal

Using a grating spectrograph in the first order spectra from 6000 Å to 8000 Å have been obtained with a dispersion of 110 Å/mm of the stars HD 192103 and HD 192163. Wavelengths have been measured and the identifications made indicate the presence of the lines of He I, He II, C II, C III, C IV and N II, N III. The equivalent widths of the emission lines have also been measured, in particular that of the hydrogenic transition in C IV at λ 7726 Å. The electron density in the zone of emission has been derived from the profile of this line.

17. On the Exact Evaluation of an Integral, in a closed Form by Weierstrass's Approximating Polynomials

SANTI RANJAN DAS GUPTA, Calcutta

In connection with the exact solution of the transport equations in the Milne-Eddington model, the author has shown that the emergent beam can be expressed in terms of integrals like

$$P(z) = \int_0^1 Q(x)dx/(x-z) \quad \dots (1)$$

where z is a complex parameter and $Q(x)$ is continuous in the closed interval $(0,1)$ and analytic in the open interval $]0,1[$. $Q(x)$ tends to $o(x)$ and $o((\ln(1-x))^{-2})$ as x tends respectively to 0 & 1.

In the present paper it is shown that such a $Q(x)$ in the integrand of (1) can be replaced by a sequence of Weierstrass's approximating polynomials $f_m(x) = a_1x + a_2x^2 + \dots + a_mx^m$, which uniformly tends to $Q(x)$ in $(0,1)$ as m tends to ∞ . Then term by term integration gives us a sequence of closed functions

$$S_m(z) = h_{m-1}(z) + f_m(z) \ln \frac{z-1}{z} \quad \dots (2)$$

which, it is shown, uniformly tends to $P(z)$ as m tends to ∞ , throughout the z -plane and at the branch points 0 & 1 at which $P(z)$ is uniformly bounded; and where $h_{m-1}(z)$ and $f_m(z)$ are polynomials in z such that $h_{m-1}(z)$ and $f_m(z)$ are uniformly convergent in the closed interval $(0,1)$, being continuous in the closed interval $(0,1)$ and analytic in the open interval $]0,1[$ for every m and when m tends to ∞ .

Such a sequence of uniformly convergent closed functions $S_m(z)$ holomorphic in the complement of the branch cut $(0,1)$ on the real axis, makes it possible in the case of our transport problems where $P(z)$ will be involved, to replace $P(z)$ effectively by $S_m(z)$ in every respect except for a uniformly small error in numerical values, where m is finite but sufficiently large; this small error uniformly tends to zero as m tends to ∞ , and m can be made to tend to infinity, if necessary, after operations like differentiations or integrations in which $P(z)$ is likely to be involved. Representation of $P(z)$ as the uniform limit of the sequence $\{S_m(z)\}$ proves to be of great advantage and saves a good deal of labour in numerical computations specially in the complicated cases of transport equations.

Fluid Mechanics

18. Self-Diffusion of Radioactive Ions in Aqueous Media

H. J. ARNIKAR and R. TRIPATHI, Varanasi

Gel columns of 2-3% agar-agar are shown to be convenient media for studying self-diffusion of ions in aqueous solutions of their salts. By virtue of its structure the gel holds, semi-immobilised, over 95% water in the net-work of its capillaries; the corresponding effect of any convection current is reduced to a negligible minimum. The method consists in setting a narrow (2-3 mm) zone of the gel containing the salt, one of whose ions is labelled, in the centre of a 25 cm. long column thereof, the composition of the latter is identical in respect of both the salt and the gel content, except that the salt is unlabelled. The system is maintained at constant temperature for about 24 hours; the gel column is then withdrawn and sliced into a series of 5 mm. wide samples. These are carefully dehydrated and the *r partition* of the tracer ion is determined, as a function of distance (x) from origin, by measuring the activity (a) of each of these samples. From the slope of the linear plot of $\log a$ versus x^2 , the coefficient of self-diffusion (D^*) is readily calculated.

Results for the coefficient of self-diffusion obtained by the above procedure are presented for (a) the SO_4^{4-} labelled with S^{35} in solution of $(\text{NH}_4)_2\text{SO}_4$ of concentrations varied from 10^{-5} N to 2N, at the temperature of 35°C , (b) Na^+ (labelled with Na^{22}) in NaCl 1N, and 2N and (c) H_2PO_4^- —(labelled with P^{32}) in NaH_2PO_4 .1N.

19. Viscosity and Thermal Conductivity of a few Nonpolar Organic Vapours

M. N. SHARMA and M. P. MADAN, Lucknow

The Chapman-Enskog theory of non-uniform gases has been applied to study the intermolecular forces between non-polar complex molecules. The potential parameters of the Lennard-Jones 12 : 6 and the modified Buckingham Exp : 6 potential energy functions have been determined utilizing the temperature dependence of the coefficient of viscosity. The theory and the experiment have been compared by calculating another transport property viz., the coefficient of thermal conductivity. Agreement is reasonable and exhibits the extent to which a non-spherical molecule can be handled with the Chapman-Enskog theory and at the same time confirms the earlier view of Madan, Halford *et al.* and others that the Exp : 6 potential is no better than the Lennard-Jones 12 : 6 potential in predicting the proportion of gases.

20. A Simple Method of finding the Ratio of Surface Tension of a Liquid to its Viscosity

GOPALA MENON SREEKANTATH, Ernakulam

An investigation of the motion of a liquid up a capillary tube—inner radius r —kept at a very small inclination θ to the horizontal has yielded a very simple and accurate method for finding the ratio of surface tension to viscosity— T/η . The thread of liquid moves up the tube under the influence of surface tensional force, but its motion is retarded by viscous drag and by the component of the weight of the thread acting down the tube. The motion is so slow that the position of the meniscus can be noted at equal intervals of time and the velocity of the meniscus v corresponding to a length x of the thread easily evaluated. It can be theoretically established that the plot of v against $1/x$ is a straight line and is represented by the equation

$$m/x - K = v$$

where $m = rT \cos \alpha / 4\eta$, α being the angle of contact and K a constant.

The slope of this straight line yields the value of m and therefore the ratio T/η . The method has been applied to a number of liquids and very satisfactory results obtained. It is particularly suitable for liquids available only in very small quantities.

21. Free Volume Approach to Polyisobutylene Melt Viscosity Under Pressure

HARKRISHAN SINGH, Chandigarh

The effect of temperature on polyisobutylene melt viscosity has been studied by Williams. The present paper deals with the effect of pressure on polyisobutylene melt viscosity. To study this effect a new parameter a_p which is defined as the ratio of relaxation times at any pressure to the relaxation time at a standard pressure (atmospheric pressure in this case) has been introduced. The values of a_p at various pressures have been calculated by using Bueche's viscosity equation. As an independent check values of a_p have also been calculated by the method of reduced variables developed by Ferry and his co-workers. As a result it is found that there is very good agreement between the values calculated by the two methods.

Acoustics

22. Ultrasonic Dispersion in Electrolytic Solutions

BH. KRISHNAMURTY, Waltair

Measurements of dispersion of ultrasonic velocity are made in aqueous solutions of five I-I valent electrolytes. The velocities are determined at five intermediate frequencies between 2.5 and 23 Mc/sec., and at the three concentrations of 0.001, 0.01 and 0.1 mole in the case of each electrolyte. Dispersion curves representing the relation of V^2 to $\log N$ are drawn, and the percentage amount of dispersion is calculated at each concentration. The curves indicate that a maximum velocity is shown at a frequency very nearly 12.5 Mc/sec. It decreases on either side of this frequency and is almost the same at the lowest and the highest frequencies taken up in this investigation. The percentage amount of dispersion is found to decrease with increasing concentration. The results are in conformity with the theoretical suggestions made by the author on the basis of the Debye-Huckel theory in an earlier publication.

23. Dependence of Musical Quality on Relative Phase of Harmonics

H. V. MODAK, Poona

Timbre is that characteristic of a tone which depends on its harmonic structure. The question naturally arises whether timbre depends only on the relative intensities of the harmonics or whether it depends also on the relative phases. This question has been studied by Helmholtz, Koenig and many others since then.

It has been accepted that variations of relative phase are without any recognizable effect on tone quality although differences in relative phase produce differences in wave forms.

It has however, been found by the present author that the 'quality' of a tone is affected when the relative phases of the harmonics are *changing*, though in steady state differences in relative phase have negligible effect on the quality. The paper describes an experiment which leads to this result.

24. Hypersonic Velocity in Viscous Liquids as revealed from Brillouin Spectra

S. N. SEN, Calcutta

Taking into consideration Lamb's theory for the propagation of high frequency acoustical waves in viscous liquids, and the idea of Maxwell regarding complex viscosity a theoretical expression has been deduced for the velocity of high frequency acoustical waves through viscous liquids. It is observed that if Frankel's expression for the rigidity-modulus of a liquid be introduced into the formula for wave propagation then the theoretical formula explains the dispersion of sound velocity in viscous liquids as was observed by Venketeswaran from Brillouin spectra and the theoretical value is in very good agreement with the experimental results. Further, the introduction of complex viscosity partly explains the propagation of these high frequency waves through viscous liquids.

25. Quantitative Noise Level Limits for Automobiles

A. F. CHHAPGAR and R. K. KHANNA, New Delhi

At present the traffic laws do not prescribe any quantitative noise level limits for different kinds of automotive vehicles.

With a view to formulating limits of the maximum permissible noise levels in order to mitigate the street noise nuisance, a systematic survey was undertaken in Bombay covering several vehicles of different kinds, and makes, in different states of maintenance and under different running conditions. The results were compared with subjective jury ratings of the noisiness of the vehicles, so that noise levels beyond which any vehicle appears to be objectionably noisy can be proscribed and enforced by the traffic authorities. The paper discusses the methods of measurement, the precautions to be observed, the amount of correlation between subjective and objective measurements, and various other points raised during the measurements. The position obtained in other countries on traffic noise regulations is also reviewed. Tentative suggestions are made to discard or quieten all vehicles with overall noise levels above 107 db to prescribe 97 db for passenger cars and light motor cycles and 102 db for heavy motor cycles and buses and trucks as the permissible upper limit for noise levels, the measurements to be made with a sound level meter with flat characteristic at a distance of 5 feet from the vehicle in an open space with low background noise.

26. Noise Comfort in Industrial Workshops.

V. NARASIMHAN, Roorkee

Problems connected with high noise levels in and around workshops and factories assume great importance in the context of the present tempo of industrial expansion planned for in India. It is imperative that these problems are given careful consideration even now and standards of acceptable noise levels formulated with special reference to Indian conditions and suitability for practical adoption. This paper deals with the tests to be carried out for the estimation of the noise levels usually met with in the context, and their general significance to this question. The experimental results obtained in a small workshop are presented as an illustration of the needed approach.

27. Temperature Coefficient of Ultrasonic Absorption and Velocity in several Alkyl Acetates at about 9 Mc/sec

S. S. MATHUR, New Delhi

Absorption coefficient and velocity of ultrasonic waves have been determined in several alkyl acetates using the pulse technique. The work has been done at a frequency of about 9 Mc/sec and extended over a temperature range of 10°–50°C. It has been observed that while the velocity in all cases decreases with the increase of temperature, the absorption coefficient behaves differently. For certain liquids the temperature coefficient of absorption is positive and for some others, it is negative. However, there are certain cases, where absorption has positive temperature coefficient in one region of temperature and negative in the other, the transition from one region to the other being regular. Moreover, the temperature coefficients in case of Ethyl acetate, propyl acetate and Butyl acetate are small whereas for Methyl acetate and octyl acetate they are comparatively larger, being positive in the first and negative in the other. The variation of absorption with temperature in Isopropyl acetate and Isobutyl acetate is found to be different from these in the corresponding normal liquids.

28. Ultrasonic Velocity in Supercooled Liquids

V. N. BINDAL, New Delhi

Velocity of ultrasonic waves has been studied over a range of temperatures, extending into the supercooled region, in five liquids viz., Thymol, Phenol, Salol, Benzophenone, and Diphenylamine.

It is observed that the temperature coefficient of velocity $\frac{1}{v} \frac{dv}{dt}$, does not remain the same on either side of the melting points in Thymol and Benzophenone. Salol, Diphenylamine and Benzophenone show a small abrupt change in velocity values as the melting point is crossed. These changes are attributed to possible structural changes encountered during transition from the liquid to the supercooled state. Phenol does not show any discontinuity and the gradient is also the same over the whole range. As phenol is highly hygroscopic it is likely to be mixed with certain amount of water and presumably the presence of water masks the small variation in temperature gradient if any.

29. Velocity of Ultrasonic Waves in Water and Heavy Water Vapour

M. PANCHOLY, New Delhi

Velocity of ultrasonic waves in Heavy water (D_2O) vapour has been measured by the variable path gas interferometer at a frequency of 203 Kc and f/p range of 2 to 12 Mc/atm. The results are compared with values obtained by similar measurements on H_2O vapour. No detectable change of velocity with f/p value is observed in the range investigated.

30. Acceleration of Esterification Reaction by Ultrasonics

T. K. SAKSENA, New Delhi

The effect of ultrasonic irradiation on the rate of Esterification of Ethyl Alcohol with Acetic Acid has been studied with the help of infra-red spectroscopy. It is observed that the infra-red absorption band of free water at about 6.15μ grows as the reaction proceeds. The growth of this band is found to be more rapid if the system is exposed to ultrasonic waves, other conditions remaining the same.

Spectroscopy

31. Ultra-violet Spectra of some Ketones and their Derivatives.

K. P. VERMA, Naini Tal

Hantzsch has reported the absorption spectra of chloroethyl acetate in pure state and in alcoholic solutions. In the study of the absorption spectra of formyl chloroethyl acetate in different solvents a few interesting results have been obtained, with the help of Uvispek Photo-electric spectro-photometer with quartz parts. The intense absorption in 240 to $245 m\mu$ region supports the chemical observation that the compound is almost pure enol; and the bathochromic displacement is due to electron repelling (OH) group attached to one end of the enol form.

Quantitative study of the absorption spectra of solutions of some newly synthesised compounds such as bromo-oxymethylene acetophenone, bromo-oxymethylene *p*-chloroacetophenone and their derivatives and bromo-oxymethylene *p*-bromo-acetophenone, has been made with a view to elucidating their structures.

α -formyl acetophenone undergoes self-condensation resulting in the formation of symmetrical tribenzoyl benzene. But α -bromo α -formyl acetophenone, which mostly exists in the enol form, is a stable compound, and its absorption spectra have been studied in the ultra-violet region.

32. Study of Fluorescence of Dyestuff in different Viscous Media at two Different Wavelengths

R. N. PANDITRAO and D. D. DESAI, Bombay

The measurement of degree of polarisation, which is affected by viscosity, temperature and the concentration of the dyestuff solution is also dependent on the nature of the solvent and the wavelength of excitation. The intensity of fluorescence of a substance may vary considerably with the change of the solvent.

The study of the solvent effect has been carried out on two dyestuffs—(i) Aconon Phloxine and (ii) Eosin in varying concentrations (5×10^{-7} gms/cc to 10^{-4} gms/cc) in the solvents such as (1) glycerine and (2) castor oil (as very viscous media); and (3) Paraffin liquid, (4) Coconut oil, (5) Til oil, (6) Groundnut oil (as low viscous media),

The exciting radiations are 4358 Å and 5461 Å lines of mercury source.

The results are interpreted in terms of the ratio $\left(\frac{\tau_0 - \tau}{\tau} \right)$ where τ_0 and τ are the magnitudes of durations of fluorescence in unextinguished and extinguished solutions respectively; and its significance is discussed in terms of concentration and fluidity of the solvents as discussed by Sveshnikov and Tishchenko.

33. The Raman Effect in Mixtures of Acetophenone with Methanol and Phenol

P. G. PURANIK, Hyderabad

Acetophenone has two C-C bonds, one C-CH₃ and the other C-C₆H₅. On the formation of hydrogen bonds the C=O bond weakens. This is not an isolated phenomenon. This leads to the strengthening of the two adjoining bonds. The weakening of the C=O bond affects the vibrations of the ketonic group.

34. Intensity of Raman Lines in Carboxylic Acids

K. VENKATESWARLU and C. BALASUBRAMANIAN, Annamalainagar

The intensity of characteristic vibrations in various carboxylic acids has been investigated. The following conclusions have been arrived at from the present investigation.

1) The intensity of C=O vibration in propionic acid is found to be greater than that in acetic acid, but in formic acid, the first member of the series, it shows an abnormally high value.

2) The intensities of the lines in the regions 1400 cm⁻¹ and 1250 cm⁻¹ corresponding to C-O vibration coupled with OH in plane deformation vibration behave in the same way, viz., that as we proceed from formic acid to higher series the intensity is found to increase gradually.

3) The intensity of OH deformation vibration behaves in a different way from that of other carboxylic acid vibrations. The intensity corresponding to a higher member of the carboxylic acid series is found to be less than that of the lower member.

35. Effect of Temperature on the Intensities of Raman Lines

K. VENKATESWARLU and K. RAMASWAMY, Annamalainagar

The intensities of the Raman lines of *O*-chlorophenol have been investigated at 303°, 355° and 391° K. It has been found that all the Stokes lines increase in intensity with increase of temperature. The anti-Stokes line at 176 cm⁻¹ also increase in intensity with increase of temperature. These conclusions are in conformity with Placzek's theory. The ratio of the intensities of the Stokes to the anti-Stokes lines at different temperatures is also in agreement with the theory.

36. Raman Effect in Binary Liquid Mixtures

K. VENKATESWARLU and MISS S. MARIAM, Annamalainagar

Raman spectra of three binary liquid mixtures, namely, methyl alcohol-*n* hexane, phenol-benzyl alcohol and aniline-phenol have been recorded at various concentrations. No frequency shifts have been observed in all the cases. Considerable changes indicating large deviations from the proportionably to the concentration, in the intensities of some of the prominent lines of the constituent liquids, particularly near the azeotropic concentration in the last two mixtures, have been recorded.

37. Potential Constants of S_2O_3 Radical

K. VENKATESWARLU and S. SWETHARANYAM, Annamalainagar

Taking the S_2O_3 radical as possessing the C_{3v} symmetry, the following potential constants (expressed in 10^5 dynes per cm.) have been calculated using Wilson's F-G matrix method.

$$\begin{array}{ll} f_D = 4.8; & f_d = 7.32; \\ f_{Dd} = 0.10; & f_{dd} = 0.32; \\ f_a = 0.58; & f_\beta = 0.53; \\ f_{\alpha\alpha} = 0.03; & f_{\beta\beta} = 0.03; \end{array}$$

and $f_{\alpha\beta} = 0.10$ where f_D , f_d , f_a and f_β are the S-S stretching S-O stretching, O-S-O bending and O-S-S bending constants respectively and the others are the interaction constants.

38. Potential Constants of I_nI_4 and ZnI_4 .

K. VENKATESWARLU and G. NAGARAJAN, Annamalainagar

The force constants of I_nI_4 and ZnI_4 have been calculated by the Wilson's Group-theoretical method making use of Raman Effect data. The values of the potential constants (expressed in 10^5 dynes per cm.) f_d , f_a , f_{dd} , f_{da} and $f_{\alpha\alpha}$, which have the usual significance, are for,

$$\begin{array}{llll} I_nI_4 : f_d = 1.3325; & f_a = 0.5588; & f_{dd} = 0.0376; & f_{da} = 0.5763; \\ & & & f_{\alpha\alpha} = 0.2574. \\ ZnI_4 : f_d = 1.2518; & f_a = 0.4178; & f_{dd} = -0.0461; & f_{da} = 0.5034; \\ & & & f_{\alpha\alpha} = 0.1848. \end{array}$$

39. Correlation and Classification of Raman Frequencies of Benzoquinone

RAMA SHANKAR SINGH, Banaras

Raman frequencies of benzoquinone have been reported by two sets of workers. However, no assignment of the vibrations to the respective symmetry species has been done by any of them. There is also some disagreement as regards the value of some frequencies in the two sets of data.

The present work on the absorption spectra of the molecule in the vapour state enables one to correlate these frequencies. Also, on the basis of the intensity of bands

in the visible spectrum, an attempt has been made to assign these vibrations to their symmetry species. This has been possible because the forbidden A_u-A_g transition in this case is made allowed by a non-totally symmetric 'g' vibration inducing a vibration moment in the plane of the molecule and along para oxygens.

40. Polarisation Character of the Raman Spectrum of Mercuric Chloride Solution

J. R. SARAF and P. N. SHARMA, Lucknow

The polarisation photograph obtained for the Raman spectrum of an aq. solution of Mercuric chloride shows that the single Raman line at $\Delta\nu$ 330 is polarised. A linear symmetrical model for the HgCl_2 molecule is suggested, at any rate, in the state of solution.

41. Studies in the Extreme Ultra-Violet and Soft X-Ray Region

R. K. TANDON, Lucknow

A detailed study of experimental investigations on the radiations emitted from solid substances in the wavelength region 40–200 Å, is given. A 2-Metre grazing incidence Vacuum Spectrograph has been used. The approximate values of the energy spread of the metal bands have been calculated. This provides a method of determining the number of conduction electrons per atom in a metal. Microphotometric records have been obtained.

42. A Photographic Projective Construction of a Uniform Chromaticity Diagram.

W. J. JOHN, Kanpur

Several linear and non-linear projections of the I.C.I. chromaticity diagram have been made in order to give visually equal chromaticity differences by equal spacings in the diagram. They are very cumbersome to calculate and even the results are only approximate. This paper deals with a photographic method of construction of uniform chromaticity diagram.

The criterion most widely used for judging the effectiveness of the uniform chromaticity charts is the equal spacing of the Munsell samples. In the I.C.I. chromaticity diagram the Munsell loci are ellipses to a first approximate. In the ideal uniform chromaticity diagram these would be even circles with uniform spacings between them.

The author has photographed the Munsell locii and tried its projection on inclined plane and curved surface so that the projected locii are very nearly circles.

It will be seen that even with large deformation of coordinates no true uniform chromaticity diagram can be made. The usual equal chromaticity diagrams are plain projections which give equal chromaticity only in the centre of the diagram. The projection on a curved surface which extends the range of equal chromaticity nearly assembles a polar log graph in which $x = y^2$ attempted by Farnworth in USA.

Studies in Colour Domain—II

43. Construction of a two Dimensional Non-Euclidean Colour Surface.

W. J. JOHN, Kanpur

The nature of the true colour domain in which distances in any direction represent equal differences in perception has been found to be a very complicated non-Euclidean domain. For equiluminous colours it is a complicated surface of variable curvature, a two dimensional manifold which can be embedded in a three dimensional Euclidean space. This paper deals with the actual modelling of such a surface.

The surface is defined by its line element $ds^2 = g_{11}dx^2 + 2g_{12}dx.dy + g_{22}dy^2$. The g_{ik} 's have been determined from experimental data for different regions of the chromaticity diagram. The determinant 'g' of the metric tensor g_{ik} has been calculated for different parts of the I.C.I. diagram; with the help of these data the true colour surface has been explored for the whole chromaticity diagram.

The chromaticity diagram was divided into very small squares and the corresponding parallelograms of the true surface worked out. These were cut out on paper and joined together to give the required surface. The paper includes a photograph of the model made by the author.

Studies in Colour Domain—III

44. Application of Non-Euclidean Colour Domain in practical Colour Requirements

W. J. JOHN, Kanpur

In the previous paper the author has divided the I.C.I. chromaticity diagram into small squares and the values of the g_{ik} 's of the line element and the determinant 'g' of the metric tensor g_{ik} have been determined for each of the small squares. Each of these small squares transforms to a parallelogram of sides $\sqrt{g_{11}}dx$, $\sqrt{g_{22}}dy$ and the included angle 'ω' given by $\cos^{-1}g_{12}/(g_{11}g_{22})^{1/2}$.

Thus any small portion of the true colour surface can be constructed as a plane diagram with coordinates inclined at an angle of 'ω'. Such a portion of the true colour surface can be used for specification purposes and to study small colour differences.

As an example the specification for a few acceptable colours for textile samples of nearly same brightness has been plotted on a coordinate system as obtained above and all the acceptable samples are found to be within limits of twice the unit circle defined by Mac Adam ellipses.

Studies in Colour Domain—IV

45. Three Dimensional Colour Domain

W. J. JOHN, Kanpur

The two dimensional non-Euclidean surface is applicable only to equiluminous colours. The variation of a colour with brightness is approximately given by Weber-Fechner law that for perceptible discrimination $\Delta Y/Y$ is a constant where Y is the brightness of one colour.

The three-fold thus built has one of the principal curvatures zero and the other two are variable. It is shown that a model of such a space can be built in 3 dimensional space.

If the scale of brightness is in terms of Munsell value, then the difference between two colours is given by

$$\Delta E = (dS^2 + dV^2)^{\frac{1}{2}}$$

For acceptable difference in colour, it has been found that ΔE should be

$$\left[\left(\frac{dS}{2.5} \right)^2 + \left(\frac{dV}{0.15} \right)^2 \right]^{\frac{1}{2}}$$

Further work in this direction is being continued

46. The Raman Spectrum of Gaseous Trifluoroethylene

N. A. NARASIMHAM, Bombay

The Raman spectrum of gaseous trifluoroethylene has been obtained on a three-prism glass spectrograph with a linear dispersion of 15Å/mm at 4358Å. On the basis of the nature of the Raman bands, the following vibrational assignment of the frequencies has been made.

α' : (170), 484, 625, 929, 1172, ~1270, ~1354, 1786, 3163.

α'' : (220), 554, 750.

The frequencies given in parenthesis lie close to the strong exciting line and are, therefore, not very certain. The rest of the assignments agree very well with those made by Mann, Acquista and Plyler on the basis of the infra-red spectrum of the trifluoroethylene.

47. Infra-red and Raman Spectra of Meta-fluorobromo and Meta-fluoroiodo Benzenes

S. L. N. G. KRISHNAMACHARI, Bombay

The infra-red spectra of *m*-Fluorobromo and *m*-Fluoroiodo benzenes have been obtained in the liquid and vapour phases in the region 2–25 μ with a Leitz semi-automatic prism spectrograph equipped with NaCl and KBr prisms. The Raman spectra of the above two compounds have been obtained in the liquid state with a two prism spectrograph of linear dispersion 30Å/m.m. at 4358Å. The observed infra-red and Raman bands are interpreted in terms of the 30 fundamental vibrational frequencies of each of the molecules. The selected fundamentals are classified into planar and non-planar vibrations and assigned to the approximate modes of vibration of the molecules. The strong and polarised Raman band at 1000 cm⁻¹ which appears as a characteristic feature of the Raman spectra of these meta compounds can be used for the analytical purposes of differentiating the meta isomers in the presence of the ortho and para ones.

48. Spectrographic Estimation of Scandium.

T. R. SARANATHAN and T. SESHAN, Bombay

Radioactive scandium mixed with the ocean silt was found useful in the investigation of sand movement due to ocean currents near Bombay harbour areas. A method of determination of the scandium content in silt or glass is desired. The spectrographic method established for this purpose is described. The method is based on anode excitation by 220 volts D.C. 10 amps and utilize Ti as the internal standard. The ratio lines used are ScII 3353.7 Å and TiII 3335.2 Å. The method is suitable for the estimation of scandium in the range 0.1 to 5 p.p.m. on 10 gm sample. The method is first used to test the recovery of scandium from silt by a chemical separation process. Scandium in silt or glass samples is chemically separated, concentrated and obtained in HNO₃ solution to which Ti (internal standard 400 $\sqrt{\text{TiG}_2/\text{ml}}$) in the form of a sulphate solution is then added and made up into one ml. A known aliquot of this nitrate is deposited and dried on a graphite electrode and used as the anode in the spectrochemical method. Comparative results on the estimation of scandium in different samples by the spectrochemical and activation analyses are also given.

49. Interpretation of the Violet Companion Bands in the Spectra of Uranyl Sulphate

BHUWAN CHANDRA PANDEY, Bombay

The fluorescence and absorption spectra of uranyl sulphate were studied. The ratio of the intensities of fluorescence bands excited by 4935Å and 4890Å radiations, was determined photoelectrically. This ratio was found to agree well with an intensity ratio calculated on the assumption that the electronic level responsible for the violet companion bands lies near the upper electronic state separated from it by 242 cm⁻¹.

50. The Ultraviolet Absorption Spectrum of Ortho-Chloro-Benzaldehyde

I. ACHYUTA RAO and V. RAMAKRISHNA RAO, Waltair

The near ultraviolet absorption spectrum of Ortho-Chloro-Benzaldehyde has been studied in vapour phase. Path lengths of 30, 75 and 150 cm. are used, and the temperature of the container is varied from -15° to 250°C. Three systems of bands have been observed in the regions—(i) 3930–3160Å, (ii) 3035–2735Å, and (iii) 2525–2415Å. The systems are in the increasing order of their intensities.

Bands in system (i) are very diffuse. About sixty bands are measured in this system. The 0,0 band is identified at 3860.2Å. The most prominent fundamental in the excited state is 1336 cm⁻¹.

Bands in system (ii) are sharp. About seventy bands are measured in this system. The 0,0 band is identified at 2986.5Å. The most prominent fundamentals in the excited state are 978, 1068 and 1188 cm⁻¹.

Bands in system (iii) are diffuse. About twenty bands are measured in this system. The 0,0 band is identified at 2487.3Å.

The Bands observed in each system are interpreted on the basis of fundamentals identified in lower and upper states. The three systems have been attributed to different electronic transitions, $n-\pi^*$, or $\pi-\pi^*$.

The Raman spectrum of the compound has been re-investigated and twelve new and weak Raman lines have been measured.

51. Electronic Spectra of α -fluoronaphthalene in the Liquid and Solid states.

S. B. BANERJEE, Calcutta

The electronic absorption spectra of α -fluoronaphthalene in the liquid and solid states have been analysed and compared with the spectrum of the compound in the vapour state reported by previous workers. The substance in different states is found to exhibit two systems of bands in the 3200–3000 A.U. and 2900–2600 A.U. regions. The 0,0 band of the first system shows a shift of 442 cm^{-1} towards red when the vapour is liquefied. When the liquid is solidified and cooled to -180°C , the 0,0 band is further displaced slightly towards longer wavelengths and the bands become sharper. The second system of bands due to the liquid consists of very broad bands and the 0,0 band is shifted towards red by about 1100 cm^{-1} from its position in the spectrum due to the vapour. With solidification of the liquid no further change is observed in this system.

52. Infra-red Absorption Spectra of Diamonds of different Types

S. C. SIRKAR, Calcutta

The infra-red absorption spectra of ten specimens of diamond of which the fluorescence and absorption spectra had been studied earlier were investigated using a Perkin-Elmer Model 21 spectrophotometer. Two of these diamonds transparent upto about 2300 \AA in the ultraviolet region and producing no fluorescence band at 4156 \AA exhibit weak infra-red absorption not in the same region but in different regions, while the other specimens show some or all the absorption bands reported by previous workers. It has been concluded from these results that these infra-red bands are due to impurities and are not characteristics of the diamond lattice.

53. r -Centroids and their Properties for $(B^1\Sigma \rightarrow X^1\Sigma)$ System of BeO.

N. SREEDHARA MURTHY and N. R. TAWDE, Dharwar

The r -centroids for the bands of BeO ($B \rightarrow X$) system have been computed by (i) the quadratic equation procedure and (ii) the method of numerical integration with the use of Morse wave function. The results from these two treatments have been subjected to a comparative study. The smooth relationship between r -centroid and wave-length follows as a consequence of this study.

54. Spectral Intensity Perturbations by Krypton in Nitrogen

D. R. BAGALKOTI and N. R. TAWDE, Dharwar

The earlier study of intensity perturbations in N_2 band systems (Ind. Sc. Cong. Abs. 1959, p. 38) has been extended to four different N_2 -Kr mixture discharges under constant current and constant total pressure. From these observations intensity enhancement factors have been obtained in terms of the ratio of over all N_2 populations $\sum_{v'} \sum_{v''} I/v^4$ under mixture condition to that under pure nitrogen case.

A further aspect of study is the investigation of intensity I as a function of discharge current O under constant total pressure of the mixtures. A linear relation of the form $I = a + bO$ has been evolved, as a result of this study. This has been used to discuss the excitation processes causing N_2IP and N_2IIP systems.

55. A Note on Philip's Profile Method of Determining Relative Transition Probabilities.

M. I. SAVADATTI and N. R. TAWDE, Dharwar

Philips (1954) offered a new method of measuring relative transition probabilities by comparing the observed and theoretical intensity profiles of bands, thus avoiding the use of integrated intensities. This method has been critically examined in this paper, in terms of the results of relative transition probabilities for C_2 (Swan) and TiO (∞) bands. Some anomalies have been noticed in the arguments given by the author to build up the method. As a result of this, the results are capable of interpretation and conclusions of widely varying character. The possible approach to meet these anomalies has been indicated in the paper.

56. On the Potential Energy Functions of the Excited States of Diatomic Molecules

V. D. KARPI, M. R. KATTI and N. R. TAWDE, Dharwar

The model presented by Keyes (J. Chem. Phys., **29**, 523, 1958) for the potentials of the excited states of diatomic molecules assuming Morse function has been examined in detail and the performance of the particular relation for the rotation vibration interaction constant σ_e has been studied in the light of similar relations available from the properties of various potential energy functions. It is found that this study leads to conclusions similar to those noted by Keyes with respect to the choice of a standard state.

57. Temperature Measurements in Discharge Tubes

V. V. BAGALKOTI and N. R. TAWDE, Dharwar

Earlier investigations have reported in a number of cases that Maxwell-Boltzmann distribution of rotational or vibrational energy in the same discharge or arc for two different radicals, does not correspond to the same effective temperature. In order to see whether this distribution is disturbed by external temperature conditions, rotational intensity distribution study has been made by varying the temperature, external to the discharge. The radicals excited are C_2 Swan ($^3\pi \rightarrow ^3\pi$) and CH 4315 ($^2\Delta \rightarrow ^2\pi$) in a special type of discharge tube. Heating of the discharge tube was effected by surrounding the positive column with a heating coil, and the intensity distribution was measured under varying currents through it. The results of temperatures derived from them show that the initial disparity between them is altered to some extent by the imposed external temperature conditions.

58. Study of the Fluorescent Yield of the Dyestuff Solutions for two different Wavelengths

R. N. PANDITRAO and D. D. DESAI, Bombay

During the course of investigations of the polarisation of the fluorescent radiation emitted by the dyestuffs (i) Acrinol Phloxine and (ii) Eosin in glycerine, when excited by linearly polarised monochromatic light, it was thought desirable to determine the fluorescent yield of these solutions for two wavelengths $\lambda = 4358 \text{ \AA}$ and $\lambda = 5461 \text{ \AA}$. It is measured by (i) the photomultiplier and (ii) the photographic photometry methods.

In the photomultiplier method the intensity of the fluorescent radiation is proportional to the deflection d . Therefore, the deflections d_1 and d_2 for parallel and perpendicular components were noted and the sum total ($d_1 + d_2$) is taken as a quantity proportional to the intensity of the fluorescent light. For this the ratio of the fluorescent yield, for the exciting wave lengths ($\lambda = 4358$ and $\lambda = 5461 \text{ \AA}$) is estimated.

This value is compared with that obtained by using the method of photographic photometry.

The results show that the ratio of the fluorescent yields obtained by both the methods agree fairly well with each other.

59. The Role of Xenon on the Intensity Distribution of some Bands of Nitrogen

S. B. RAICHUR and D. D. DESAI, Bombay

The investigations presented in this paper concern the study of the characteristics of the development of 1(P) and 2(P) systems of nitrogen in admixture of nitrogen and xenon in discharge tube of usual π type with a view to study the changes in the intensity distribution as caused by xenon in varying amounts. The effect of increasing the pressure of xenon with a trace of nitrogen in the discharge tube has also been studied for four typical bands of 2(P) system of nitrogen viz., (0, 0), (0, 1), (0, 2) and (1, 0) bands.

The intensities of the bands of 2(P) system are calculated from the method of integrated intensities, in addition to the peak intensity values.

60. The Nature of Luminescence Emission in Silver activated Sodium Chloride

S. B. BHATTACHERJEE, D. K. SARASWATI and SANTIBRATA BHATTACHERJEE,
Calcutta

The incorporation of Silver in Sodium Chloride greatly enhances the luminescence efficiency of the phosphor. The position of the band maxima in the after-glow of the phosphor irradiated by cathode rays at liquid oxygen temperature is at $403 \text{ m}\mu$, with a weak diffuse band approximately at $520 \text{ m}\mu$. In the thermoluminescence emission, the single glow-peak band maxima is at $403 \text{ m}\mu$, the glow temperature being 160°K .

Since the glow-peak temperature observed in the present case is coincident with the first glow-peak of the pure sample, the emission in both the cases are obviously due to the release of holes from the same traps—the longer wavelength component observed in pure sample being absent in the present case. Thus incorporation of Silver effects the luminescence centres as also the trapping centres.

61. Emission Spectra of *m*-dichlorobenzene

N. L. SINGH and D. K. GHOSH, Banaras

The emission spectrum of *m*-dichlorobenzene has been photographed on a Hilger medium quartz spectrograph. The flowing vapour of the substance was excited by an uncondensed transformer discharge. The spectrum consists of about 30 bands lying in the region $2750\text{--}3050 \text{ \AA}$. Assuming C_{2v} point group to hold approximately in the molecule the spectrum has been interpreted as an allowed transition between $B_1 - A_1$. A tentative vibrational analysis has been proposed in terms of ground state frequencies which are correlated with the known Raman frequencies of the molecule.

62. On the Emission Spectrum of *p*-chlorophenol

K. N. UPADHYA and N. L. SINGH, Banaras

The emission spectrum of *p*-chlorophenol molecule has been developed in High Frequency discharge through the flowing vapour of the substance. The bands were photographed on a Hilger medium quartz spectrograph. The complete spectrum lies in the range of 2870–3057 Å consisting of nearly 20 sharp bands degraded towards red. Assuming a C_{2v} symmetry of the molecule, bands have been analysed and an interpretation of the observed frequencies have been given. The bands with medium and strong intensities observed at 34560, 34445, 34180, 33983 and 33730 cm^{-1} involve frequencies 262, 377, 642, 839 and 1092 cm^{-1} in the ground state. Out of these frequencies, 377, 642, 839 and 1092 have been correlated with the Raman lines at 382, 634, 836 and 1091 cm^{-1} respectively. No correlation could be made for 262 cm^{-1} frequency, since the corresponding Raman line is missing.

63. On the Emission Spectrum of NiCl

N. SUNDARACHARY and N. L. SINGH, Banaras

The emission spectrum in the region 5500–3800 Å of NiCl have been excited by transformer discharge and the spectrum is photographed in the 2nd order of a 21 ft. concave grating (1.3 Å/mm). Along with several new groups of bands, partially resolved rotational structure of single-headed and double-headed bands have been recorded by us. Tentative analysis of these bands indicates the transition between quartet terms in NiCl molecule is doubtful.

64. Emission Spectrum of Hg_2 Molecule

N. L. SINGH and G. VENKATESWARLU, Banaras

The bands due to mercury lying in the region 2555–2534 Å have been excited by uncondensed transformer discharge and photographed in the second order of a 21 ft. grating spectrograph with a dispersion of 1.3 Å/mm. Some of these groups of bands were photographed already by previous workers but not analysed. With clear vibrational structure as developed on our plates, it has been possible to analyse some of these bands into three systems and for two of them the constants have been evaluated. For two systems (including the one for which the constants have not been evaluated) the emitter is known to be Hg_2 molecule and the ground state frequency of the same is found to be 40.2 cm^{-1} .

For an analysis and interpretation of the remaining bands further work is in progress.

65. Thermoluminescence of Potassium Chloride activated by Impurity or by Mechanical Strain

R. V. JOSHI, Baroda

The thermoluminescence measurements were made with potassium chloride phosphors activated independently by thallium, strontium and barium and also by mechanical strain. Electron traps of the same depth are observed in each one of these phosphors. It is therefore suggested that the trapping states responsible for the phosphorescent decay of KCl:Ti phosphor cannot be metastable levels of the

substitutional Tl ion, as assumed by Seitz (1938) and supported by Johnson and Williams (1953), but exist at neighbouring sites of the distorted lattice.

66. Peak and True Intensities of a Band and Their Correlation

S. B. RAICHUR and D. D. DESAI, Bombay

The investigations presented concern the study of the characteristics of the development of 1(P) and 2(P) systems of nitrogen in admixture of nitrogen and xenon in discharge tube of usual π type with a view to study the changes in the intensity distribution as caused by xenon in varying amounts. The effect of increasing the pressure of xenon with a trace of nitrogen in the discharge tube has also been studied for four typical bands of 2(P) system of nitrogen, viz. (0,0), (0,1), (0,2) and (1,0) bands.

The intensities of the bands of 2(P) system are calculated from the method of integrated intensities, in addition to the peak intensity values.

67. Excitation of Nitrogen Bands in the Auroral Spectra

S. N. GHOSH and B. N. SRIVASTAVA, Allahabad

The mechanisms for the excitation of 1st negative bands of N_2^+ and positive bands of N_2 have been discussed and have been attributed to charge exchange reactions between protons emanated from the sun and atmospheric N_2 molecules. On the other hand, the excitation of N_2^+ Meinel bands which is also observed in the auroral spectra has been shown to be due to a charge exchange mechanism involving $O^+(2D)$ and N_2 molecules. The intensities of these bands have been calculated according to the proposed mechanisms and have been shown to agree with the observed intensities.

68. Excitation of green and red Auroral Lines in the Night Airglow

A. SHARMA and S. N. GHOSH, Allahabad

All possible excitation mechanisms of night airglow emission are considered in the light of the recent rocket observations of the altitudes of different emissions and the quenching of excited oxygen atoms in the upper atmosphere. It is found that Chapman's mechanism can only explain the observed behaviour of λ 5577 line. The cause of the diurnal variation of the intensity of this line is attributed to the tidal oscillations in the upper atmosphere. It is also found that turbulence is responsible for the irregular variations of its intensity.

Heat & Thermodynamics

69. Local Variations of Air Temperature at Delhi

K. S. AGARWALA, New Delhi

In this paper the results of analysis of the monthly mean maximum and minimum air temperatures recorded at three observatories situated at (a) Safdarjung Airport, (b) Lodi Road and (c) Palam Airport in the Delhi area during the years 1955-57 have been given and the local variations of temperatures have been discussed.

70. Probability-Distribution Associated with Thermodynamic Problems

M. DUTTA, Calcutta

In a number of papers (Dutta, 1953, '55, '59) it is shown that thermodynamic problems can be fully investigated from entirely statistical considerations. In these investigations, the entire discussion is based on probability distributions amongst states, written from some probabilistic considerations similar to the Bayes' theorem. The probability distribution amongst states (cf. Dutta, 1959) is taken as

$$P_{t,M,E} = p(t, z, E, M) = \frac{t^{MzE}}{\sum \sum W(M, E) t^{MzE}} \quad (1)$$

where t, z are statistics of distribution, E, M are energy and mass of the system in the state under consideration; $W(M, E)$ is the number of states corresponding to M and E ; \sum is summation over all possible values of M and E . In this note, the probability distribution (1) has been deduced by a method frequently used in the Information Theory for determining the probability distribution (Khinchin, 1957; Goldmann, 1953).

71. Thermal Conductivity of Binary Mixtures of Diatomic and Monatomic Gases.

B. N. SRIVASTAVA and A. K. BARUA, Calcutta

Thermal conductivity of the binary mixtures O_2 -He, O_2 -Ne, O_2 -Kr and O_2 -Xe have been measured at 30°C and 45°C for various compositions by using the thick-wire-variant of the hot-wire method. For pure O_2 the experimental value of the thermal conductivity is lower than that given by the recent theory of Hirschfelder and consequently the values calculated from Hirschfelder's formula for the mixture conductivities are also expected to be higher than the experimental values which is actually found to be so for the mixtures investigated here. The agreement becomes excellent when the experimental values of the conductivity of pure O_2 are used to calculate the mixture conductivities. The formula for the mixture conductivities has been tested in detail and found to give satisfactorily the composition dependence. The simpler formula for the thermal conductivity of gas mixtures given by Mason and Saxena has also been tested.

72. Thermal Conductivity and Eucken Type Correction for Binary Mixtures of N_2 with some Rare Gases

A. K. BARUA, Calcutta

The thick-wire variant of the hot-wire method has been used to measure the thermal conductivity of the binary mixtures N_2 -He, N_2 -Ne, N_2 -Kr and N_2 -Xe at 30°C and 45°C. The experimental data for pure N_2 and the binary mixtures have been compared with the recent theory of Hirschfelder. Reasons have been put forward for the discrepancy observed between the experimental and the calculated values of the thermal conductivity of pure N_2 given by Hirschfelder's theory. The formula for the thermal conductivity of gas mixtures is found to represent the concentration dependence of the conductivity satisfactorily. The simpler formula for the thermal conductivity of gas mixtures given by Mason and Saxena has also been tested.

73. Diffusion Coefficients of Gases from the Rate of Approach to the Steady State in Thermal Diffusion

S. C. SAXENA and E. A. MASON, New Haven

The rate of approach to the steady state in a convection-free two-bulb thermal diffusion experiment is treated in a more rigorous manner than previously available, in order that reliable ordinary diffusion coefficients may be derived from thermal diffusion measurements. The final results are of the same form as in the original simplified Jones and Furry treatment, but the parameters are now interpreted somewhat differently and a new correction term appears. Application to Nettley's measurements on H_2-N_2 mixtures removes an apparent discrepancy with the kinetic theory prediction of the composition dependence of the diffusion coefficient for this system.

74. Thermal Conductivity of Multicomponent Gas Mixtures—II

E. A. MASON and S. C. SAXENA, New Haven

An investigation is made of the accuracies of the two recently derived formulae for the translation thermal conductivity of multicomponent gas mixtures. It is found that neither formula is sufficiently accurate in all cases, but that a slight modification of the Muckenfuss-Curtiss formula makes it as accurate as current experimental measurements. The modification consists of the replacement of first approximations to binary diffusion coefficients by more accurate values.

75. Thermal Diffusion and the Approach to the Steady State in Gases II.

S. C. SAXENA and E. A. MASON, New Haven

The theory of the rate of approach to the steady state in thermal diffusion is tested experimentally on the systems He-Ar, He-CO₂, H₂-CO₂, and D₂-CO₂ over a temperature range of about -78° to $325^\circ C$. The course of the diffusion has been followed by means of the radioactive tracers Ar³⁷ and C¹⁴O₂. The theory appears to be verified, and the results are used to calculate ordinary diffusion coefficients, which are in reasonable accord with previous measurements by other techniques. The thermal diffusion factors, which are obtained from the same measurements, also appear to have reasonable accuracy. The experimental method therefore appears to have promise as a sensitive method for the determination of forces between unlike molecules.

76. Free Convictional Heat Transfer from a Horizontal Wire

P. K. KORANNE, D. V. GOGATE and R. D. RAO, Baroda

When heat is transferred by free convection from a solid body to a fluid, it is generally believed that a functional relationship of the form: $Nu = f(Gr.Pr)$ exists between the Nusselt number $Nu \left(= \frac{h}{k_\theta} \right)$ and the product of Grashof number $Gr \left(= \frac{g\theta l^3 \rho^2}{\mu^2} \right)$ and the Prandtl number $Pr \left(= \frac{c\mu}{k} \right)$. The generality of this relationship has however recently been questioned and it was therefore thought desirable to

make additional measurements of the heat transfer for different ranges of $(Gr.Pr)$. Accordingly, the amount of heat transfer was measured in the following liquids; Water, ethyl alcohol, Benzene, Methyl alcohol, toluene, CCl_4 and aniline, using a single copper wire of different diameters. The values of $\log Nu$ obtained for different wires are plotted against $\log (Gr.Pr)$ and the results obtained are compared with those of other workers. The experiments were repeated with platinum wires also.

77. Convectonal Heat Exchange and Reynolds Number

H. S. DESAI and D. V. GOGATE, Baroda

Some experiments on heat exchange between solids and flowing streams of air are described in this paper. After a brief discussion of the relation between heat transfer and momentum transfer, the values of Nusselt number and drag coefficient are exhibited for different Reynolds numbers. It is shown that the rate of heat exchange undergoes a relatively sudden change in the region of Reynolds number 10^5 and that it is this region where the nature of flow pattern changes.

Metal vessels of various shapes such as cylinders, spheres and parallelopipeds are used with different characteristic lengths and the amount of heat transmission is calculated for different Reynolds numbers. The values of shape constants are also determined for these different vessels and it is shown that the values of these constants show some variation when the flow is not strictly laminar.

78. Thermal Expansion of Single Phase Binary Alloys containing Copper and Aluminium

G. B. MITRA, Kharagpur

Extremely precise measurements of the lattice constants of two single phase Cu-Al alloys containing (i) 0.08% by weight of copper in Aluminium, (ii) 5.87% by weight of aluminium in copper of spectroscopic purity have been carried out at different temperatures ranging between 300°K to 800°K. X-ray diffraction powder techniques have been employed for the purpose. For attaining extreme accuracy of measurements, Sinclayers and Floyd's extrapolation method was utilised. The results can be summarised by the equations

$$(i) \quad a_T = 4.0460_5 + 8.85 \times 10^{-5}T + 8.57 \times 10^{-8}T^2 - 1.5 \times 10^{-10}T^3.$$

$$(ii) \quad a_T = 3.6456_1 + 6.12 \times 10^{-5}T + 2.33 \times 10^{-8}T^2.$$

for the two cases respectively where a_T is lattice constant of the alloy at $T^\circ\text{C}$.

Electricity & Magnetism

79. Temperature-dependence of the Induced Conductivity at the Surface of Contact between Potassium and Magnesium Metals

S. K. SEN and S. D. CHATTERJEE, Calcutta

The surface of contact between K and Mg metals, kept in an inert medium and suitably pressure adjusted, shows non-linear characteristic with a polarising Voltage upto ± 0.2 Volt. When this Value is exceeded the contact surface ceases to be

rectifying and shows high resistance in either direction, Under such circumstances, the response-recovery curves of the contact surface corresponding to suitable electrical pulses are of the positive type even when the P.V. is maintained in either direction. However, the shape of the recovery curves are quite different in the two cases. For example, a slow recovery curve under the influence of negative, P.V. becomes extremely fast when the P.V. is made positive.

An additional feature reveals itself, when the contact surface has slowly recovered from an electrical stress in the blocking direction. Indeed, after the original high resistance has been recovered, if the P.V. is made positive, a sharp conduction pulse is obtained, simulating an artificial electrical pulse. A detailed study of the nature of the conduction pulse has been made under varying conditions of the ambient temperature.

A theoretical interpretation of these phenomena is given.

80. Calculation and Measurement of Dielectric Constant and Loss for Rutile single Crystals at very low Frequency

K. G. SRIVASTAVA, Allahabad

A report is made of observed values of dielectric constant and dielectric loss for single crystals of rutile (Titanium Di-Oxide) at low frequencies (2 to 100 cycles per second) by bridge techniques. Results obtained are also plotted on Cole-Cole plot to obtain segment of circle, which is completed by extrapolation to obtain the static value of dielectric constant. Measurements of charging and discharging curves at low and comparatively higher voltages are also given for direct current fields. From these curves calculations have been made of alternating current behaviour of crystals at low frequencies by using Hamon's formula. Alternative method of calculation by Field assuming networks of R-C circuits is not used since errors in computation are larger. It is noticed that errors in computation for Hamon's formula also become quite big above .002 cycles to question the validity of such calculations. It is, therefore, suggested to extend the measurements for still lower frequencies and to produce a larger number of electrons in crystals by X-ray and beta-ray irradiation.

81. Dielectric Constant and Loss Measurement in Polar Liquids in the Microwave Region

S. K. GARG, Allahabad

A modified experimental method for the measurement of dielectric properties of medium and high loss liquids at 10, 3, 1.25 and .8 cm wavelength having arrangement to work at temperatures from -60°C to 80°C is described. The method utilizes a long waveguide cell terminated in a movable short circuit. The standing wave ratios are measured at intervals as the length of the dielectric liquid column in the waveguide is changed. The method of measuring the wavelength of the radiation in the liquid filled waveguide and the percentage error for such approximation is indicated. From the values of λ_{gd} and standing wave ratios ρ , ϵ' and ϵ'' are calculated.

The apparatus is standardised with Benzene (distilled and dried over sodium) whose static dielectric constant is measured to be 2.276 at 25°C . The value of this Benzene was found to be 2.2736 and 2.2810 at 3 and 10 cm. respectively. The values

so obtained are at least within 1% of the values quoted in the literature. The dielectric loss was found to be practically zero at both the frequencies.

The results for pure Triethylamine (distilled and dried over KOH) are $\epsilon' = 2.40$ and $\epsilon'' = 0.8876$ at 3.1 cm. and $\epsilon' = 2.44$ and $\epsilon'' = 0.4432$ at 10 cm. at 25°C. No measurements are available for pure Alkyl amines in this region. The static dielectric constant of Triethylamine was measured to be 2.46 at 25°C.

82. Effect of Heat Treatment on the Resistivity and Optical Transmission of thin Silver Films

V. V. SHAH and Y. G. NAIK, Ahmedabad

Silver films prepared by evaporation technique at room temperature show a resistance minimum on heating, the exact temperature (corresponding to resistance minimum) depending upon the thickness of the film. A further increase in temperature either renders the film discontinuous, thereby indicating the formation of agglomerates, or behaves normally. The resistance minimum is assumed to be due to removal of strain and imperfections in the film by the heating process. Decay energies for the removal of distortions are calculated on the basis of the theory of Vand.

Transmission readings in the range 3200 A.U. to 10,000 A.U. are taken before and after heat treatment. The effect of heating is to increase the transmission in the near infra-red and to lower it in the visible region, whereas in the ultraviolet, it remains practically constant.

However, in all the films, irrespective of heat treatment a transmission maximum is observed at 33,000 A.U.

83. On the Temperature Variation of the Resistance of thin Films of Tellurium

S. K. GHOSH, Kharagpur

A study of the temperature variation of the resistance of thin films of tellurium (obtained by vacuum evaporation) shows the existence of large number barriers in the path of current flow. The barrier height, as estimated from the slope of the experimental curve, yields a value of the order of 0.18 e.v.

84. Paramagnetic Resonance in Free Radical

PREM SWARUP and B. N. MISRA, Allahabad

A 21 Mcps paramagnetic resonance spectrometer has been set up and the arrangements are underway to enable the measurements to be made at low temperatures. The paramagnetic resonance line of Diphenyl Picryl Hydrazyl has been studied at 21 Mc/sec at room temperature and at 9200 Mc/sec at temperatures down to liquid helium. The line width at room temperature has been found to be 1.2 Oersteds at 21 Mc/sec and 2 Oersteds at 9200 Mc/sec. The value is comparable to values of other authors varying from 1 to 3 Oersteds. It is suggested that this variation is due to the different packing of the D.P.P.H. powder because of the strong exchange occurring between the

paramagnetic ions responsible for the narrowing of the resonance line. The exchange integral decreases rapidly with the distance between the ions. The line width slowly increases to 5 Oersteds at liquid helium temperature (4.2°K) measured at 9200 Mc/sec. The line showed no signs of saturation even at 100 milliwatts of microwave power indicating that the spin-lattice relaxation time is less than 2 microseconds. The line-shape is Lorentzian, as expected in exchange narrowed lines. D.P.P.H. is a very good reference paramagnetic substance for the measurement of the spin lattice relaxation times of other salts although the number of spins in a given sample decreases with time or in sunlight unlike Vanadyl Chelate.

85. The Influence of a Magnetic Field on the Stability of a Gravitating Cylinder

F. C. AULUCK and D. S. KOTHARI, Delhi

The paper deals with the stability of a gravitating cylinder subject to the influence of a magnetic field; the material is assumed to be incompressible, inviscid and infinitely conducting. The fields investigated so far have been either constant inside or outside the cylinder or arise from currents with current-density proportional to the distance from the axis of the cylinder. In this paper we investigate current-distributions which keep the cylinder in equilibrium such that both the current-density and the field decrease exponentially from the axis towards the surface of the cylinder. The field outside the cylinder is constant and is parallel to the axis of the cylinder.

86. Hydromagnetic Stability of a conducting inviscid, incompressible Fluid of variable Density

S. P. TALWAR, Delhi

The Rayleigh and Taylor instabilities of an incompressible, inviscid, perfectly conducting fluid of variable density is studied under the presence of a horizontal magnetic field. Having established the equations of the problem two special cases of density distribution are studied in detail. The main result is that the magnetic field has a stabilising influence on the configuration in either case and that the magnetic field may bring about stability in the configuration when it is thoroughly unstable without a field.

87. Dipole Moment of Dyes

N. H. PANDHARE and D. D. DESAI, Bombay

The dipole moments of (1) Waxolene Rhodamine B.S. and (2) Waxolene yellow ADS are measured by taking the dilute solutions of these dyes in non-polar and slightly polar solvents, namely (1) Benzene, (2) Toluene. The first one is non-polar while the latter is slightly polar. The dielectric constant of the solutions is determined by using beat frequency method. One is a crystal oscillator with frequency 3207.5 K.C./sec. The variation in capacity is measured by precision standard air condenser, supplied by Messrs. Muirhead and Co. The molar polarization at infinite dilution of the solute is determined by graphical extrapolation.

The refractive index is determined for D-line of sodium using the Abbey auto-collimating refractometer. As usual the electronic polarization is determined by the method of "Least Squares", and is found fairly constant within the range of concentrations taken. The effect of the polar solvent on the dye molecule is also determined. The work with Xylene as solvent is in progress.

88. On the Stability of an infinitely long self-gravitating Cylinder in the Presence of an axial Magnetic Field.

R. K. JAGGI, New Delhi

In this paper we have applied the normal mode method of Kruskal and Schwarzschild to study the stability of an infinitely long self gravitating cylinder in the presence of an axial magnetic field. It is concluded that the stable length of such a cylinder is about sixty times its radius when the strength of the field is about 10^{-6} gauss. This shows that the effect of axial magnetic field on the cylinder is highly stabilizing (the stable length of a self-gravitating cylinder without the axial magnetic field being only 6 times the radius.).

89. Dielectric Constant of a dense Electron Gas.

T. PRADHAN and P. MISRA, Cuttack

The problem of absorption and dispersion of electromagnetic waves in a dense electron gas is treated semi-classically through the use of Boltzmann equation and Fermi-Dirac statistics. The singularity in the dispersion formula is treated by the method of Van Kampen. Expressions for the dielectric constant and conductivity as functions of frequency have been obtained for temperatures at and near absolute zero.

90. Recent Palaeomagnetic Studies in India

C. RADHAKRISHNAMURTHY and P. W. SAHASRABUDHE, Bombay

Palaeomagnetic investigations of rocks from various countries indicate that large-scale movements have taken place of either the geomagnetic poles, or the various land masses, with respect to the rotational axis of the earth. Our earlier results from the Deccan traps have shown that during Cretaceous to Eocene period, either India was well south of the Equator, or that the North Magnetic Pole was somewhere in the middle of North America. The results from Rajmahal traps have also shown similar results with even greater displacements than those given by the Deccan traps. The dykes in the Deccan traps in the Poona region, and the Cuddapah traps, are also being studied in order to trace the positions of the magnetic poles or the land mass of India during the corresponding Geological periods.

An interesting feature of the results from the Deccan traps is that they can be safely divided into two parts: (1) the Lower traps—which are reversely magnetized with a steep downward inclination, and (2) the Upper traps, which are normally magnetized with a somewhat shallower upward inclination.

91. Relaxation Phenomenon in Paramagnetic Salt

PREM SWARUP, Allahabad

Spin-spin and spin-lattice relaxation times have been measured in paramagnetic single crystals at very low temperatures in the 3 cm region. The crystals studied

are of potassium cobalticyanide containing 0.1 to 20% of paramagnetic chromium ions replacing diamagnetic Cobalt. It is found that at concentrations below 5%, the resonance line shape is truly Lorentzian and that the line can be represented by Bloch equation for the susceptibility, viz.,

$$\chi''(\nu) = \pi \chi_0 \nu_0 T_2 / [1 + 4\pi^2(\nu_0 - \nu)^2 T_2^2 + \frac{1}{4}\gamma^2 H_1^2 T_1 T_2]$$

where T_2 is the spin-spin and T_1 the spin lattice relaxation time and the other symbols have usual meaning. From the above relation, the ratio of the saturated line width to the low power line width comes out to be :

$$\frac{(\Delta\nu)^{sat}}{(\Delta\nu)_0} = (1 + \frac{1}{4}\gamma^2 H_1^2 T_1 T_2)^{\frac{1}{2}}$$

At room temperature the line width of 0.5% Cr salt ($-\frac{1}{2} \rightarrow +\frac{1}{2}$) transition was 9 oersteds which was entirely due to T_2 (8×10^{-9} sec.). The width remained at 9 oe. on cooling down to 4.2°K at 100 microwatt of $r-f$ power. At 4.2°K, the saturation was observed setting in at 100 watts and at higher power the line width increased and the $r-f$ susceptibility decreased according to Bloch equation. The value of T_1 was 0.02 sec. which decreased at $1/T$ at higher temperatures. The saturation curves of $r-f$ susceptibility indicate the possibility of two spin-lattice relaxation times involving hot phonons at large saturating power. The data are still under analysis and full report will appear elsewhere.

92. Dipole Moment of Dyes.

N. H. PANDHARE and D. D. DESARI, Bombay

The dipole moments of (1) Waxoline Rhodamine B.S. and (2) Waxoline yellow ADS are measured by taking the dilute solutions of these dyes in non-polar and slightly polar solvents, namely, (1) Benzene, (2) Toluene. The first one is non-polar while the latter is slightly polar. The dielectric constant of the solutions is determined by using beat frequency method. One is a crystal oscillator with frequency 3202.5 K.C./sec. The variation in capacity is measured by precision standard air condenser, supplied by Messrs. Muirhead and Co. The molar polarization at infinite dilution of the solute is determined by graphical extrapolation.

The refractive index is determined for D-line of sodium using the Abbey auto-collimating refractometer. As usual the electronic polarization is determined by the method of "Least Squares", and is found fairly constant within the range of concentrations taken. The effect of the polar solvent on the dye molecule is also determined. The work with Xylene as solvent is in progress.

X-Ray & Gas Discharge

93. Influence of various Parameters on Joshi Effect in a Metal Electrode Discharge.

V. G. KHER, Nagpur

Consequent on the discovery of the conditions under which a metal electrode discharge current is affected by irradiation of the discharge tube, investigations were taken up to study this effect under various operating conditions. It is found that

the range and magnitude of Joshi effect in a metal electrode tube containing gases at low pressure, were optimum for a suitable combination of C and R . In one particular case these values were 25pf. and 100 k ohms respectively. If the capacity is greater than 200pf. the effect vanished in most of the tubes. Comparison of tubes with and without a capillary constriction in the centre shows that nearly 100% light effect is observed over a considerable range of voltages beyond threshold for the tubes with a constriction. Experiments with neon, argon and helium discharge tubes showed that % light effect was maximum for argon and minimum for neon under otherwise identical conditions. A number of metal electrode discharge tubes with different geometries and containing various gases were subjected to a.c. voltages at frequencies ranging from 50 to 5000 cy/sec. It was found that the light effect decreases rapidly with increase of frequency in all the cases and vanishes at about 300 cy/sec. Based on the earlier work of the author possible explanation of the above observations is given.

94. Effect of Irradiation on the Noise Radiation from an Ozoniser Discharge.

M. G. KELKAR, Amravati

Systematic observations on the effect of irradiation with visible light on the noise radiation from an ozoniser discharge containing air at low pressure are reported. As the radiation is pulse modulated, observations were carried out on the detected r.f. as well as its modulation part. The amplitude of the current in the detector in both the r.f. and the modulation part is considerably reduced on irradiation. The percentage reduction in the modulated part is, however, considerably larger than the percentage reduction in the r.f. part.

This reduction of current is explained on the basis of the theory of an ozoniser discharge. This discharge is intermittent and consists of a first large current pulse followed by a number of discrete small current pulses in each half cycle of the exciting voltage. Oscillographic observations reveal that this large current pulse is considerably reduced in height on irradiation (Joshi effect) while the other current pulses remain practically unaffected.

As the generation of noise is mostly due to the sudden burst of current, at the instant of the large current pulse a reduction in the height of this pulse on irradiation produces a corresponding reduction in the amplitude of the noise radiation. Since the production of the r.f. noise is entirely due to the unequal heights of this large current pulse in the two halves of an A.C. Cycle (because of the non-symmetrical nature of the electrodes) a considerable reduction in the modulation part of the detected r.f. is recorded due to its preferential suppression.

95. The Joshi Effect and the Photo-sensitivity of Counters

H. J. ARNIKAR, G. RAMIREDDY and SOME NATH CHAKRAVARTY, Varanasi

The earlier work of one of us (H.J.A.) on the photo-sensitivity of G.M. Counter filled with (Argon 90% + Alcohol 10%) is now extended to tubes filled with Hydrogen ($p \approx 60$ mm) and I_2 vapour. These are excited by stabilized high voltage supply, and the pulses amplified and measured by an electronic scaling circuit of 64 in the potential region 0.90 to 1.5 kV and for irradiation by light from a 75 watt lamp of

intensity varied in the range 1 : 20 and with a γ source from a 50 mC radium source. A complete suppression of counts under light as well as under γ is reported corresponding changes in the number and the shape of pulses are also recorded with a Dumont Cathode Oscillograph.

96. Diffraction of X-rays by essential Oils

K. VENKATESWARLU and S. PADMANABHA PILLAI, Annamalainagar

Employing Copper $K\alpha$ radiation X-ray diffraction by some essential oils has been studied. The patterns given by the oils and their chief constituents agree very well. But Eucalyptus and Cajeputi oil on the one hand and Anethole and Aniseed oil on the other show a striking difference in the scattering. While an exposure time of $1\frac{1}{2}$ hours was sufficient to get a good pattern in the first two oils, an exposure time of 5 hours was required and the pattern was diffuse in the case of the latter two oils. It may be due to the molecules being arranged in a chaotic form or that no particular spacing is prominent in anethole and aniseed oil.

97. The Photo-sensitive non-self-maintained Region of A.C Discharge and the Geiger Region of Counters.

B. D. KHOSLA, Delhi

To prevent the discharge from becoming continuous and self-maintained in the Geiger region of counters some quenching mechanism is employed but since no such device is used in the case of the photo-sensitive non-self-maintained region of discharge and since the latter remains active only in the presence of an external excitation, the latter cannot be considered as the Geiger region of the discharge.

98. X-ray Study of Piezoelectrically Oscillating Crystals

S. P. SINGAL, New Delhi

The internal movements of the ions of the crystal lattices of Quartz under piezo-electric Oscillations were studied by X-rays with the object of finding out any shift of the Laue spots when the crystal oscillates. The Laue patterns obtained for X-cut quartz plates vibrating in the thickness mode with X-rays incident normally on the vibrating surface as also for oblique incidence showed that there was no detectable shift in position but there was a general increase in the density of the spots as has been observed earlier.

99. X-ray Diffraction Study of the Thermal Expansion of pure Germanium

G. B. MITRA, Kharagpur

The coefficient of thermal expansion of 99.999% pure Germanium has been determined by the X-Ray diffraction powder technique. Fine powders of this sample of Germanium was packed in a thin capillary graphite tube and mounted in the centre of a Unicam 19 cm. high temperature camera. X-ray diffraction photographs at temperatures ranging between 300°K and 800°K were taken. The unit cell dimensions at these temperatures were determined on the basis of the measurements of the

(422) reflection of Germanium at the above temperatures. The results can be summarised by the formula

$$a \tau = 5.6174_5 + 3.8 \times 10^{-5} \tau + 2.4 \times 10^{-8} \tau^2 - 5.0 \times 10^{-11} \tau^3 + 5.7 \times 10^{-14} \tau^4.$$

where $a\tau$ is the unit cell parameter at $T^\circ\text{C}$.

100. X-ray Analysis of the Structure of Kopsin, $\text{C}_{22}\text{H}_{26}\text{N}_2\text{O}_4$.

LILABATI RAY and S. B. BHATTACHERJEE, Calcutta

X-ray and optical measurements show the orthorhombic nature of the crystals of Kopsin, $\text{C}_{22}\text{H}_{26}\text{N}_2\text{O}_4$, having the unit-cell dimensions, $a = 7.4 \text{ \AA}$, $b = 13.4 \text{ \AA}$ and $c = 17.9 \text{ \AA}$. The systematic absences observed lead to the space-group $P2_12_12_1$ and the density determination ($\rho = 1.224 \text{ gms/cc.}$) suggests 4 molecules of Kopsin in the unit-cell of given dimensions.

101. X-ray Diffraction Study of *Stearic Acid* by the New Technique

N. PAN, Calcutta

Diffraction study with the help of the newly developed diffraction camera coupled with the X-ray tube has already been reported. The present work on Stearic acid involved the diffraction study using Aluminium as the target material. The position of the diffraction lines experimentally obtained have been compared with the theoretically calculated glancing angles and are found to agree quite satisfactorily. Weak lines also appear in the diffraction patterns whose positions agree well with the calculated glancing angles for the Non-diagram lines of Al K_α and are interpreted as such.

102. The Forbidden Transition L_1M_1 in the Spectrum of Platinum (78)

B. G. GOKHALE, A. N. NIGAM and K. S. SRIVASTAVA, Lucknow

A 40 cm. curved mica crystal spectrograph has been used for the study of the L -spectrum of Platinum (78) with a view to removing the discrepancy in the wavelength of the L_1M_1 forbidden line as reported by Cauchois (1175.X.U.) on the one hand and by Deodhar and Mande (1182.X.U.) on the other. The present investigation has revealed the existence of a faint trace at (1167.3.X.U.), which has been assigned to the transition L_1M_1 in Platinum because of its closer agreement with the energy difference of the two levels and its closer fit with the Moseley plot. The possible causes for the discrepancy in the values reported by the earlier authors have been discussed.

103. The Number of N_2 Molecules in Earth's Atmosphere from Rocket Data

S. N. GHOSH and K. D. SHARMA, Allahabad

By utilizing the data for the intensities of solar X-rays in the different wavelength regions and the depth of penetration of these radiations in the earth's atmosphere as obtained from rocket-borne experiments, the molecular nitrogen in the atmosphere above the depth of penetration has been calculated. In these calculations, it has been assumed that the energy received from the sun is spent wholly in ionizing O_2 , O and N_2 molecules. The results are compared with other available data and are found to agree well.

Cosmic Rays

104. On the Life Time and Interactions of Heavy Mesons

B. BHOWMIK, P. C. MATHUR and P. C. JAIN, Delhi

58.6 metres of K^- track length has been followed in the energy interval 0 to 185 MeV in a G5 emulsion stack exposed to a magnetically separated beam of Heavy Mesons, from Berkeley Bevatron. The mean momentum of K^- -mesons at the point of entry in the stack is 427 MeV/c. The interaction mean free path between this energy interval is (18.7 ± 1.1) cm. The variation of interaction cross section as a function of energy has been studied and a small rise in the cross section is found at energies higher than 120 MeV. The mean life time is found to be consistent with that of K^+ within experimental errors. High value of the ratio of π mesons obtained in the K^- capture stars at rest to the π mesons produced in interactions in flight shows that the capture at rest is a surface phenomenon while capture of Heavy Mesons in flight takes place inside the nuclear volume.

105. Binding Energy of Λ_0 in ${}^4H_\Lambda$ Hyperfragment

B. BHOWMIK, P. C. JAIN and P. C. MATHUR, Delhi

While scanning and following of K^- meson tracks 20 hyperfragments were observed. Two hyperfragments decayed mesonically and 16 non-mesonically. Only two cases of non-mesonic decays of a hypernucleus in flight were observed. The two mesonically decaying hyperfragments have been uniquely identified as ${}^4H_\Lambda$ and the mean binding energy has been found to be (1.3 ± 0.6) MeV.

106. Decay Modes and Lifetime of negative heavy Mesons

B. BHOWMIK, P. C. JAIN and P. C. MATHUR, Delhi

Relative abundances of different K^- -decay modes and lifetime have been studied in a stack of G-5 emulsion, exposed to a magnetically separated beam of Heavy Mesons from Berkeley Bevatron. 17 decays in flight were obtained. The relative abundances are consistent with that of K^+ and K_{μ_2} and K_{π_2} are found to be most abundant.

The ratio $\frac{K_{\pi_2}}{K_{\mu_2}}$ is found to be 0.58. The lifetime averaged over all decay modes is found to be $(1.24 \pm 0.25) \times 10^{-8}$ sec. The effect of experimental biases is discussed and corrections are made for the scanning efficiency which is estimated to be 10% by observing the electrons from μ -decays in π - μ -e events.

107. Some Features of extensive Air Showers of Energies $> 10^{15}$ ev

B. N. SRIVASTAVA and A. N. SURI, Naini Tal

Extensive Air Showers with energies $\geq 10^{15}$ ev have been recorded at Naini Tal (Altitude 1950 m.) by means of three unshielded G.M. Counter trays, placed at a distance of 20 meters apart in a triangular lattice, in order to explore the solar anisotropy if it exists in the primaries of Cosmic Radiation in this energy range. The data of 4600 showers has been analysed for solar diurnal and semi-diurnal components.

The analysis has shown no significant solar diurnal and semi-diurnal variations. The amplitude of the diurnal component has been found to be 2.2% of the mean rate, and the time of max. at about 0100 hours local solar time. The statistical significant amplitude of the solar daily variation is only 1.3%. The semi-diurnal component is quite in-significant. Its amplitude is .83% (T max-0800 and 2000 hrs.) which is within statistical uncertainties.

The frequencies of occurrence of double and triple events has decreased at this energy as compared to the previous data reported for showers of energy $\geq 10^{14}$ ev. Their relative abundance is about 1% of the total showers recorded.

108. Performance of a large Detector of Cerenkov Radiation of single Particles in Air.

A. SUBRAMANIAN and S. D. VERMA, Bombay

A large Air Cerenkov counter, which responds to the Cerenkov radiation produced by the passage of a single charged cosmic ray particle through a column of air about two metres long at atmospheric pressure, is described. This type of detector will be of considerable use in cosmic ray and high energy physics. General considerations on the design of such a detector and its efficiency are discussed.

109. The Flux of heavy Nuclei ($Z \geq 10$) of the primary cosmic Radiation at the Top of the Earth's Atmosphere

R. R. DANIEL and N. DURGA PRASAD, Bombay

In the absence of reliable information regarding the absorption mean free path for Heavy nuclei of the primary cosmic radiation in air, it is difficult to estimate the flux of these particles at the top of the atmosphere from measurements made under appreciable amounts of matter. This difficulty can be overcome to a great extent by measuring the variation with atmospheric depth of the ratio of the number of Medium ($6 < Z < 9$) to Heavy ($Z \geq 10$) nuclei. One can then extrapolate this ratio M/H to the top of the atmosphere and thereby estimate the flux of Heavy nuclei from the known flux of M -nuclei.

An experiment has been made to measure this quantity M/H as a function of atmospheric depth, from the zenith angle variation of M/H observed in two stacks of nuclear emulsions, one vertical and one horizontal, flown in February 1956 at an altitude of 114,000 ft. over Texas, U.S.A., (geomagnetic latitude $\lambda = 41^\circ\text{N}$). The results obtained are discussed.

110. Estimation of the Relative Concentrations of Cosmic-ray produced Radio-isotopes P^{32} and P^{33} in Rain Water

P. K. ZUTSHI, Bombay

Detailed features are presented of the new scintillation counter for measurement of low level β -activity : particularly for measurements on soft β -emitters in the presence of hard β -emitters. This technique has been used for the estimation of the relative concentrations of cosmic-ray produced radio-isotopes P^{32} and P^{33} in rain water. The results and their meteorological aspects are discussed.

111. Study of Cosmic Ray produced Isotopes Be^7 , P^{32} and S^{35} and their Use in meteorology

RAMA, Bombay

Condensation processes for the extraction of radio-activity from air have been developed. Results on the concentrations of cosmic ray produced isotopes Be^7 , P^{32} and S^{35} in air and their meteorological implications are discussed.

112. Fluctuations of the Nuclear Active Component of Extensive Air Showers

B. K. CHATTERJEE, G. T. MURTHY, S. NARANAN, M. V. SRINIVASA RAO
and B. V. SREEKANTAN, Bombay

An experiment to study the fluctuations of the nuclear active component of extensive air showers has been carried out at Bombay over a period of three months. The air shower array comprises of five liquid scintillation counters each of area 1 m^2 , spread over a rectangular area of $30 \text{ m} \times 7 \text{ m}$. Five nuclear active particle detectors, each composed of six enriched BF_3 neutron counters surrounded by paraffin and lead and of effective area 0.5 m^2 , are located at the centre of the array and record the density of nuclear active particles. The amplifiers and the display system are designed to record particle densities of 1 to 1000 particles in each scintillator. The amplitudes of the scintillators enable the determination of the size and core location of each shower. Four thousand showers ranging in size from 10^4 to 2×10^6 particles with core location extending upto 25 metres from the centre of the array have been recorded and are being analysed. Experimental details and the results of analysis will be presented.

113. The Energy Spectrum of Heavy Nuclei in the Primary Cosmic Radiation

S. BISWAS, P. J. LAVAKARE, K. A. NEELAKANTAN and P. G. SHUKLA,
Bombay

The energy per nucleon of heavy primary cosmic ray nuclei traversing nuclear emulsions has been determined by measuring the angles of emission and the energies of 'knock-on' electrons which the particles produce by elastic collisions along their path. Since the energy of the 'knock-on' electron is relatively small, it can be measured with precision by the multiple scattering technique. The error on the primary energy has been evaluated in terms of the errors involved in the measurements, and the conditions for reliable determination of primary energy are discussed. The reliability of the method has been verified by comparing the results with those obtained by other methods.

Measurements were made on 291 tracks, including 206 tracks of particles with atomic number $Z \geq 6$. The exponent in the integral energy spectrum of Medium ($6 \leq Z \leq 9$) group of nuclei was obtained as 1.65 ± 0.30 and for Heavy ($Z \geq 10$) group of nuclei as 1.75 ± 0.35 , in the energy range of 0.23 to 9 BeV per nucleon.

Thus both the charge groups are found to have the same value of the exponent within experimental errors. The exponent for $S(Z \geq 6)$ group of nuclei is 1.70 ± 0.25 . The geomagnetic cut-off energy at the latitude $\lambda = 53^\circ\text{N}$ has been obtained as 230 MeV/nucleon. The values of the flux for M and H groups of nuclei are 9.7 ± 0.9

and 5.3 ± 0.6 particles/m². sec. sterad., respectively. These are about 30% lower than the normally expected values, which is probably associated with high solar activity during the period. This is in agreement with the decrease observed by McDonald in the α -particle flux in the same flight.

Radio Propagation

114. Back Scattering of short Wave Radio Signals

O. P. SINHA, Patna

Reception of short wave radio signal is possible even within the skipzone due to back scattering and hence a detailed study of this phenomena has assumed importance during recent years. The paper contains the results of the investigations made by the author on the nature and causes of the back scattering of short wave radio signal transmitted from A.I.R. Delhi. The fluctuations in the intensity of the radio signal was continuously recorded with the help of a pen-recorder actuated by the output of the second detector stage of a sensitive super het receiver, the A.V.C. of which was made inoperative. It was not possible to study the nature of back scattered components of the radio waves as long as the regular reflected components of the signal was present, but when the latter was absent, the scattered signal was always detectable, though very often it was extremely weak in the intensity. The intensity of the back scattered signal was generally found to increase with the increase of the angle of incidence of the waves. The persistence of the back scattered signal and the nature of the variation of its intensity support the view that they are mostly due to scattering by the ground. The intensity of the scattered signal was amplified and in most cases their amplitude probability distribution was found not to fit with Rayleigh probability distribution curves. It is obvious that the nature of the back scattering would depend upon the nature of the ground and hence, while in some cases it might resemble Rayleigh type of scattering, in other cases it may not be so. The presence of back scattering when there are temporary disappearances of the regularly reflected signal during day time, has been suggested by the author to be likely due to the presence of temporarily moving holes in the ionospheric layer.

115. Effect of Magnetic Field on Microwave Propagation through Waveguides and Cavities

C. S. KUMAR and R. PARSHAD, New Delhi

Magnetic field, of different field strengths, varying from zero to about six thousand gauss, has been applied parallel to both the narrow and broad sides of a rectangular wave-guide and cavity carrying microwave power at X-band in the direction perpendicular to the field.

The effect of the magnetic field is complex. For the case of the broad side of the guide and cavity, parallel to the field, the transmitted power output increases as the field increases. For the case of narrow side of cavity parallel to the field, the power output at first decreases, as the field progressively increases from zero, goes to a minimum, and then steadily increases. The effect of the field on wave-guide is about one fiftieth to one hundredth of the effect for the cavity.

The resonance frequency of the cavity increases as field is applied, the increase being of the order of 500 KCS or less in 9000 megacycles.

116. The Size of the Moving Irregularities in the *F*-region and the Angle of Spread of the Scattered Waves from Them

S. R. KHASTGIR, Calcutta and R. N. SINGH, Banaras

The three-spread-receiver fading records of the *F*-echo at 3.8 Mc/sec. taken at Banaras during the period from November 1956 to September 1958 showed certain characteristic patterns. The fading patterns which were considered as due entirely to the movement of large ionospheric irregularities were analysed by the method of Briggs and Phillips (1950). As a result of this analysis the average characteristic length of the irregularities was found to be 270 metres and the average angular spread was found to be 6°. The variations of these parameters were shown with the help of histograms. The records showed some diurnal and seasonal variations, but no definite conclusion could be made regarding such variations.

117. Polarization Curves for vertical Propagation of Radio-waves in the Ionosphere

Y. S. N. MURTY, New Delhi and S. R. KHASTGIR, Calcutta

In the present paper the curves giving the polarization angle θ and the tilt-angle ψ of the polarization ellipse for 100 m. radio waves have been drawn for the condition of the magnetic field in the Ionosphere above Banaras (Latitude 25°18'25"N, Longitude 83°0'46" E. Dip-angle 36° 24' N and $H = 0.466$ Gauss) for the values of the electron collisional frequency, $\nu = 0$, $\nu = \frac{\nu_c}{2}$ and $\nu = 2\nu_c$, (where ν_c is the critical collisional frequency) with increasing values of the electron density which make the quantity $\frac{4\pi Ne^2}{mp^2}$ vary from 0 to 2, where $\frac{4\pi Ne^2}{mp^2} = 1$ is the condition of reflection of the radio-wave of angular frequency p . In drawing these curves, we have made use of the analytical expressions obtained earlier by us from the Appleton-Hartree formulae giving the ratio of the normal to the abnormal component of the magnetic vector of the wave (i.e., components in and at right angles to the plane containing the wave-normal and the direction of the magnetic field) and the phase-difference between them. The theoretical basis of the computation is given and the sign convention for representing the polarization parameters θ and ψ is outlined. The nature of the variations in the polarization parameters computed for increasing values of electron-density is fully discussed.

118. Effect of Annular Solar Eclipse of 19th April, 1958 (at sunrise) on the F-2 Layer of the Ionosphere

S. N. MITRA and B. C. NARASINGA RAO, New Delhi

The paper describes the effect of the Annular Solar Eclipse of 19th April, 1958, on the ionisation density of the F-2 layer over Trivandrum, Tiruchirappali and Madras (South India). The eclipse occurred near sunrise at all the three places at its magnitude at maximum phase was 75 to 83%. Analysis of (foF2)² values during control period

and eclipse day showed a marked decrease in the ionisation density with the progress of the eclipse at all the three places. Theoretical considerations of the effect of an eclipse at sunrise on the ionisation density of the F2 layer are discussed which led to the determination of the value of attachment co-efficient at 350 km as approximately $10^{-5} \text{ sec.}^{-1}$ over Trivandrum.

119. Systematic flare Patrol through Longwaves

S. N. MITRA and S. C. BOSE, New Delhi

It is known that on longwave propagation through the 'D' layer of the ionosphere, the received sky-wave signal is intensified during the occurrence of a Solar Flare. This is because the reflection co-efficient of the 'D' layer increases when intense radiation (ultraviolet and X-rays) is incident on the ionosphere from an active flare region. An experimental investigation on the longwave propagation of a distant broadcasting station (Tashkent, frequency 164 Kc/s) was initiated at the Research Department of All India Radio and the received signal was recorded continuously throughout in the longwave signal (SIL) whenever a visible flare is reported from Astronomical Observatories. Data for the period August to December, 1958 have been analysed and 144 instances of sudden increases observed during the period. A correlation of this SIL with the flare data collected from all Astronomical Observatories in the world has indicated that flares of all classes (1, 1+, 2, 2+, 3, 3+) have given rise to sudden increase in amplitude of the longwave signal. The times of beginning and maximum of these two events have agreed within 5 minutes. The variation of H_u line width during a flare is also well-correlated, in some instances, with the change in the amplitude of the corresponding SIL. The height of reflection of this obliquely incident longwave station is determined from the sunrise effect and is 65 kms. The usefulness of an SIL in flare patrol and in the short term forecasting of sudden ionospheric disturbance is discussed in the paper.

Nuclear Physics

120. Thermal Neutron Absorption in Chlorine

A. M. GHOSE, Calcutta

A precise measurement of the thermal neutron absorption cross section of chlorine has been made by the spherical symmetry method developed in our laboratory and utilising a semi empirical formula for interpreting the transmission data. A new mechanical arrangement has been incorporated in the transmission instrument to integrate the neutron intensity over the surface of a sphere. Corrections have been made for multiple scattering, for non-radial flux of neutrons for neutron temperature of the moderator, shift in the velocity distribution spectrum of neutrons through preferential absorption of lower velocity neutrons in the absorber and for the alteration in the efficiency of the detector due to obliquity of the scattered neutrons. The absorption cross section of Cl in CCl_4 came out as 31.8 ± 1.6 barns. This compares favourably with the latest determinations using nuclear reactors.

121. Spectrum of Eu^{152}

P. N. MUKHERJEE, I. DUTT, A. K. SEN GUPTA and
R. L. BHATTACHARYYA, Calcutta

The spectrum of mass-spectrometrically enriched Eu^{152} has been studied using a Siegbahn-Slatis beta ray spectrometer, scintillation spectrometer and gamma-gamma coincidence device. From the analysis of the beta spectrum α_k of 344 keV gamma is found to be $0.033 \pm .001$. A low energy beta group with an end point at 417 keV is found, and to fit this to the decay scheme it has been suggested that there is a 1415 keV level in Gd^{152} which decays entirely by an emission of a 1415 keV gamma ray. α_k , K/L and L/M values of 122 keV gamma ray in Sm^{152} are compared with the theoretical values of Rose based on finite nuclear size.

122. Cross-section Measurement for (n,p) and (n,α) Reaction with 14.5 MeV Neutrons

S. K. MUKHERJEE, A. GANGULI and N. MAJUMDER, Calcutta

Three elements Br^{79} , Br^{81} , Bi^{209} and As^{75} —were bombarded with 14.5 mev neutrons obtained from low voltage accelerator from $H(d,n)He$ reaction. Their activation cross-sections for (n,p) and (n,α) reactions were measured. Neutron flux was measured accurately by means of (i) a previously calibrated fast neutron monitor in conjunction with a beam current integrator, (ii) a reference standard foil activity and (iii) nuclear emulsion plate. Radiochemical separation of the reaction products was done in each case before measurement of the activities of the products. Further measurements are in progress.

123. Nuclear Spin-echoes and Molecular Self-diffusion in Liquid

S. K. GHOSH and S. K. SINHA, Calcutta

The effect of molecular self-diffusion on the amplitudes of nuclear Spin-echoes in liquids has been calculated by treating the random displacements of the molecules by the general method of treatment applied in Markov Stochastic processes. On the basis of these calculations, an experimental method for measuring the diffusion-coefficient D for the liquid has been worked out. This independent determination of D enables one to obtain T_2 from Carr-Purcell arrangement in general cases. These methods have been used in the case of water and the values of D and T_2 obtained agreed well with the results of other experiments. Further a direct experimental check has been furnished to compare the validity of different theoretical approaches to this problem.

124. Maximum permissible Levels of internal Exposure.

S. D. SOMAN, Bombay

At present the ICRP values are (provisionally) adopted for use in India for setting up the standards for radiation protection.

The data on 'average Indian adult' available so far indicates the necessity of revision of the Maximum Permissible Body Burden and Maximum Permissible Concentration values for adoption in India. In this paper, the available Indian data connected

with the derivation of maximum permissible body burden and concentrations are given and their implications discussed. The need for data on the vital statistics of the average Indian is stressed.

Such revisions are also required for the urine tolerance values as presently adopted at the A.E.E.T. The amount of a toxic material in urine of an individual is taken to represent the soluble toxic material present in his body. In the case of long lived or stable elements, the urine tolerance values ($d/m/d$) is shown to lie between 0.75 and 15 times the maximum permissible concentration per cubic meter of air. For a number of common radioisotopes and chemically toxic substances urine tolerance values in $d/m/d$ and 31°C air in $d/m/m$ are found to be very nearly equal.

125. Some Studies of the Decay of Eu^{152}

S. JHA, H. G. DEVARE and P. AMMIRAJI, Bombay

Although ^{152}Eu is one of the best studied and best understood isotopes, some points in its decay scheme are still uncertain. Bhattacharji et al. did not find any K X-ray and 122 Kev γ -ray in coincidence with the 1410 Kev γ -ray and concluded that 1410 Kev state of Sm^{152} is fed only by L electron capture; the electron capture decay energy of Eu^{152} is about 1460 Kev, and that this state de-excites by transition to the ground state. Alburgher et al. have found the electron capture decay energy of Eu^{152} to be 1859 Kev. Nathan et al. have found K X-rays and 122 Kev γ -ray in coincidence with the 1410 Kev γ -ray.

In this paper summing in a single crystal, sum coincidence technique and conventional coincidence methods have been used to show that the 1410 Kev γ -ray is in coincidence with 122 Kev gamma ray and K X-ray. The known electron capture decay energy of Eu^{152} has been used to examine the theoretical relation between the K and L electron capture probabilities and the decay energy. Beta spectrum has been studied in a magnetic lens spectrometer.

126. Radioactivity Buildup in Cyclic Irradiation

D. V. GOPINATH, Bombay

An exact expression for the radioactivity buildup in cyclic nuclear operations has been derived. The expression, in addition to taking into account the burnup of the parent due to neutron irradiation other than leading to the radioisotope in question, also takes account for the depletion of the resultant radioisotope by neutron capture. Simplifications of this general expression leading to well known approximate formula are presented.

127. A Modified Way of Collecting the Recoil Products of (n,γ) Reaction

H. J. ARNIKAR and ANANT LAL, Varanasi

Products of radioactive decay and fragments of nuclear reactions are frequently charged. The use of static electric fields to collect such charged fragments has been found to be effective sometimes. We have developed a new method of collecting the charged fragments of (n,γ) reaction resulting from the irradiation of organic liquids by a 50 mC $\text{Ra}(+\text{Be})$ neutron source. In the previous methods, the electrodes had

to be chemically treated to recover the fragments collected thereon. In the present technique, the electrodes serve both as electrodes and as chemical absorbers of the charged radioisotopes produced. We coat the copper electrodes with a film of 2% gel of agar-agar containing a trace of alkali. The product sought, say, radiobromine or radioiodine, separating by Szilard-Chalner process of recoil following the emission of α , is readily absorbed by the gel. Its subsequent recovery is very simple. The gel is scraped out of the electrode surface and evaporated. The desired isotope is thus recovered without a carrier. The yields on the positive and negative electrodes in the irradiation of bromobenzene is, for instance, in the ratio of 2 : 1.

128. On the Gamma-rays from Ba^{131} and Nd^{147}

S. JHA and R. M. SINGRU, Bombay

Photo-electrons ejected by the gamma rays of Ba^{131} and Nd^{147} from 20 mg/cm² gold radiators have been studied in a lens type beta ray spectrometer. The photo-electron peaks observed in the study of Ba^{131} have been interpreted as being caused by the gamma rays of energies 82 Kev, 126 Kev, 139 Kev, 216 Kev, 241 Kev, 249 Kev, 370 Kev, 493 Kev, 620 Kev, 820 Kev, 920 Kev and 1030 Kev. The gamma rays of energy 405 Kev and 585 Kev also seem to appear. In the case of Nd^{147} , photo-electron peaks due to gamma rays of energies 92 Kev, 120 Kev, 160 Kev, 277 Kev, 320 Kev, 410 Kev, 440 Kev, 525 Kev, 600 Kev and 690 Kev have been observed.

129. On the Decay of Xe^{127}

S. JHA and M. NARAYANA RAO, Bombay

Xe^{127} was made by the deuteron bombardment of iodine in the Cyclotron of Birmingham University. The radioactive gaseous Xe^{127} was deposited in an electrical discharge on a thin aluminium foil. The source was used for the study of gamma rays in a Scintillation Spectrometer. The sum coincidence technique was utilized to find the relative intensities of the cascades 175 Kev + 204 Kev and 175 Kev + 145 Kev + 57 Kev. By measuring the *K* X-rays in coincidence with the 377 Kev γ -ray, the total electron capture decay energy was measured to be 430 ± 5 Kev.

130. Further Work on the Decay of Cs^{132} .

S. JHA and G. C. PRAMILA, Bombay

The 6-day ^{132}Cs has been prepared from the reaction $^{130}\text{Ba}(n,\gamma)^{131}\text{Ba} \rightarrow ^{131}\text{Cs}(n,\gamma)^{132}\text{Cs}$ by irradiating 100 mg. of barium to the neutron flux of $10^{14}/\text{cm}^2 \times \text{sec.}$ in Dido, Harwell, England. The carrier-free isotope was studied in a Scintillation Spectrometer and Coincidence Spectrometer. Gamma rays of energy 670 Kev, 780 Kev, 880 Kev, 1060 Kev, 1150 Kev and 1360 Kev were observed. The 670 Kev gamma was shown to be in coincidence with 1320 Kev γ -ray. The existence of annihilation radiation in coincidence with 670 Kev γ -ray confirms the positron decay of Cs^{132} to the first excited state of Xe^{132} . The positron spectrum, studied with an anthracene crystal, seemed to extend up to about 1600 Kev.

131. Radioactive Decay of Erbium—171.

B. L. SHARMA, Dhanbad

Er_2O_3 enriched in isotope Er^{170} (87.3%) was exposed to a thermal neutron flux of $10^{12} \text{ cm}^{-2} \text{ sec}^{-1}$. The half-life of Er^{171} was determined to be 7.5 hours by following the decay of the various gamma ray photopeaks with scintillation spectrometers. The 113- and 308-keV gamma ray groups were observed to be in coincidence, and were found to be in agreement with the previously reported results. It was evident from the well crystal measurements that the previously reported 360- and 420-keV peaks were sum peaks of Tm K X-ray and 308 keV gamma ray and of 113- and 308 keV gamma ray groups respectively. The only observed radiation from isotopes of erbium other than Er^{171} was the 0.33 MeV beta group of Er^{169} (9.4 days). In the present investigations, the gamma rays, emitted because of the presence of Yb, Tm, Sc and La impurities in the sample, were observed to decay on different half-lives. An examination of the radiation emitted by this sample revealed no activity which could be assigned to the previously reported 49.8 hrs. $-\text{Er}^{172}$ and 63.8 hr. $-\text{Tm}^{172}$ activities.

132. Beta Decay of Thulium—171

B. L. SHARMA, Dhanbad

In order to study the beta decay of Tm^{171} (1.9 yr.), the Er fraction, obtained by ion exchange column separation of $\text{Er}^{170} + n$, was allowed to decay for a considerable long time. The well crystal measurements were then made. Apart from Yb K X-rays and their escape peaks, the above measurements showed the presence of a highly internally converted photo peak at 67 keV. The proposed decay scheme of Tm^{171} together with the spin assignments of various states is presented.

133. Nuclear Magnetic Shielding in Molecules: Hydrogen Molecule

S. K. SINHA and A. MUKHERJI, Calcutta

A method for calculating the nuclear magnetic shielding in molecules has been developed using valence bond or LCAO type molecular orbitals. The perturbation of the molecular wave function due to a steady magnetic field is derived by solving the first order perturbation equation. The method has been applied to the calculation of proton shielding in hydrogen molecule with Wang function. A qualitative analysis has been made on earlier investigations in this line particularly from the angle of view of the gauge invariance of the wave function and the choice of the form of a variation function for the perturbation of the molecular wave function.

134. Magnetic Shielding of Proton in CH_4 Molecule

S. K. SINHA and A. MUKHERJI, Calcutta

The nuclear magnetic shielding constant for protons in tetrahedral methane molecule is calculated. Hartree-Fock wave function is used for the carbon orbitals. The perturbation of the valence bond wave function representing of C-H bond under a uniform magnetic field is determined by numerically solving the first-order perturbation

equation. The usefulness of this approach in extending the result to calculate the effect of the other C-H bonds in the methane molecule is discussed.

135. Spin of the First Excited State of B^{12}

E. KONDAISH and C. BADRINATHAN, Bombay

Angular distribution of gamma rays arising from the 0.95 Mev level of B^{12} in the reaction $B^{11} (d,p) B^{12}$, has been studied at a deuteron energy of 800 Kev. In view of the observed angular distribution, spin of the first excited level in B^{12} will be discussed.

136. Gamma-ray Transitions in Gd^{155}

B. N. SUBBA RAO, Bombay

From a study of internal conversion spectra, β -spectra and external conversion spectra (using copper, tin, and gold) with the intermediate-image β -ray spectrometer and of gamma-spectra in scintillation spectrometer conversion coefficients of 86 KeV and 105 KeV transitions in Gd^{155} have been evaluated by three different methods to be 0.50 ± 0.06 ($\alpha_{\pi\pi}^k$) and 0.31 ± 0.05 ($\alpha_{\pi\pi}^k$). These determinations conclusively indicate the predominant $E1$ nature of both transitions, thus removing the ambiguity in this regard. In an attempt to evaluate exactly the possible $M2$ admixture by combining the present data with the known L -subshell data, some regular discrepancies are observed between theoretical values of conversion coefficients and the experimental values (for the 86 KeV. transition), unless the errors in L -subshell ratios are of the order to permit an ($M2/E1$) mixture of 0 to 0.04. These observations are discussed briefly in view of the expected "hindrances" of low energy $E1$ transitions in nuclei with equilibrium spheroidal shape.

137. Neutron Energy Levels in a diffuse Potential

N. C. SIL and A. GHOSE, Calcutta

The s -state energy eigen values of neutrons moving in the spherically symmetric potential $V(r) = -V_0/[1 + e^{(r-R)/a}]$ have been calculated for $A=200$. Lawson has taken an infinite Taylor series for the solutions of the Schrodinger equation with the above potential; because of slow convergence of his series, the practical difficulties for evaluation of observable quantities are considerable. Following Lanczos, we modify the above equation by equating it to an error term instead of to zero. The error term is proportional to Tshobysheff's polynomial of a given order. As a result of this, the differential equation becomes solvable by a finite power series. The right side of the equation i.e., the error term vanishes at the zero points of the Tshebysheff's polynomial and the power series solutions thus obtained is an interpolating one. Here the error term has got an oscillatory character and it is possible to reduce the maximum error at any point of the range. The superiority of this method in finding out the eigenvalues of the equation lies in its great economy and improved efficiency as it yields with the same number of terms a much more accurate approximation than the Taylor series. The parameters involved in the potential function are the same as taken by Feshbach, Porter and Weisskopf in scattering problem.

138. Circular Polarisation of Bremsstrahlung from Polarized Protons**D. BASU and S. SARKAR, Calcutta**

We have investigated the circular polarization of bremsstrahlung radiation emitted along the incident direction of longitudinally polarized proton. McVoy, whose method we have followed here, has calculated the same effect for the case of polarized electrons.

In addition to ordinary electromagnetic interaction as used by McVoy we have taken into account the effect of the anomalous magnetic moment of protons described in terms of a Pauli type interaction with the electromagnetic field. However, we have neglected the nuclear interaction of the proton-nucleus system as has been done by Powell who has calculated the proton bremsstrahlung by the approximate method of Williams and Weizsacker.

139. Slowing Down of Neutrons in Graphite Close to Thermal Equilibrium**P. G. KHUBCHANDANI and L. S. KOTHARI, Bombay**

Elastic and one-phonon inelastic scattering cross sections of thermal neutrons in graphite have been calculated using the model of lattice vibrations proposed by Krumhansl and Brooks. Mean energy loss per collision and mean logarithmic energy decrement have also been calculated. Assuming that the neutron energy distribution is Maxwellian close to equilibrium, the time dependence of the temperature of the distribution is determined. The slowing down relaxation time comes out to be nearly 170μ sec. which compares well with experimental value of $185 \pm 45\mu$ sec.

140. Interaction Radius of Nuclei**P. K. ADITYA, Chandigarh**

An attempt has been made to correlate the experimental data on the interaction cross section of protons, α -particles and heavy primary nuclei producing interactions with various media, and find the dependance of the cross section on the radius of the nuclei involved. It is found that the "effective interaction radius" can be written in the form of the conventional relation: $R_i = r_0 A^{1/3}$ with the difference that the unit radius r_0 , though constant for the heavier targets may be allowed a slight decrease in the region of lower atomic numbers.

141. Some Consequences of Interactions Produced by Deuterons**P. K. ADITYA, Chandigarh**

In view of experimental evidence pointing to the possibility of deuterons producing nuclear disintegrations in the atmosphere, some consequences of the phenomena taking place at high energies are described. The interaction cross section of deuterons is already known to be about twice that for the protons. It is expected that the angular distribution and other characteristics of those events in which both the nucleons participate, might be much different from those events in which increased multiplicity result from plural processes. Two groups of events involving widely different multi-

plicities have been recently reported at Kiev, by a Russian group and the observation may well be attributed to this effect. It is also considered that while obtaining high energy events on the basis of their ensuing cascades, there can possibly exist a bias in collecting larger number of deuteron events than that expected from the relative abundance of the protons and the deuterons.

142. Range Energy Relation in Nuclear Emulsions

SAROJ ADITYA, Chandigarh

Ranges of π -mesons emitted at decay from a selected sample of τ -mesons and of μ -mesons from the $\pi-\mu-e$, events have been measured in a stack of emulsions of precisely known density. The angles of the three pions from the ∂ -decay were separately obtained. With the knowledge of the Q values for the decay scheme :

$$\tau^+ \rightarrow \pi^+ + \pi^\pm + \pi^\mp \text{ and } \pi^+ \rightarrow \mu^+ + \nu,$$

the data have been used to construct for nuclear emulsions, the range energy relation corresponding to protons of energy from 15 MeV to 300 MeV

143. Decay Scheme of Eu^{156} .

MISS S. Y. AMIYE, M. C. JOSHI, R. P. SHARMA and B. N. SUBBARAO,
Bombay

Eu^{156} , produced by the neutron irradiation of an enriched sample of Sm^{154} ($\text{Sm}^{154}(n\gamma)\text{Sm}^{155} \rightarrow \text{Eu}^{155}(n\gamma)\text{Eu}^{156}$), has been investigated with intermediate range β -ray spectrometer adjusted for making β - e and β - γ coincidence measurements. Scintillation spectrometers arranged for coincidence measurements were also used. Fermi analysis of the β -spectrum reveals the presence of at least four β -groups β_1 2450 ± 30 KeV, β_2 1180 ± 30 , β_3 720 ± 30 and β_4 480 ± 30 KeV. From the complex gamma-ray spectrum by a scintillation spectrometer the following gamma-rays of energies 630 ± 20 , 710 ± 20 , 810 ± 20 , 930 ± 20 , 1050 ± 20 , 1140 ± 20 , 1250 ± 20 , 1960 ± 20 , 2050 ± 20 and 2180 ± 20 have been identified. The analysis of the complex γ -ray spectrum indicates the presence of other γ -rays of energies 1380 ± 25 , 1640 ± 25 , 1750 ± 25 and 1840 ± 25 KeV. From β - e coincidence spectrum 89 KeV and 201 KeV transitions have been identified and K/L ratio for 89 KeV has been determined. Based on the experimental observation a partial decay scheme has been proposed.

144. Secondary Electron Emission from Metals by Bombardment of high Energy Hydrogen Atoms

S. P. KHARE and S. N. GHOSH, Allahabad

It is shown in a previous paper that the secondary electron emission from metals by bombardment of high energy protons is due to the ionization of target atoms. The

work is being continued for the secondary electron emission from metals by a high energy beam of neutral hydrogen atoms. It is found that the experimental results can be explained satisfactorily by considering self-ionisation of neutral beam as it traverses the target and the subsequent production of secondary electrons by protons and electrons which are formed from self-ionisation.

Crystallography

145. Hardness along Tricrystal Boundaries in Tin

N. S. PANDYA and C. J. SHAH, Baroda

Polycrystalline crystals obtained by casting on glass plate were etched by hydrochloric acid. Differential etching was revealed on tricrystal boundaries. Microhardness measurements along the grain boundaries were made by indenting with a diamond pyramidal indenter. Considering hardness as inversely proportional to energy, a relation connecting the hardness number and the sine of the equilibrium dihedral angles has been suggested which fits in well with the observations.

146. A rare Type of circular Microstructures on Dodecahedron Diamonds

D. C. PANDEYA, Saugor

Diamond is predominantly mined as Octahedra; yet in some mines the dodecahedra dominates in size and quantity. It is considered very likely that a study of the microstructures of dodecahedron diamonds may reveal the cause of variation of crystal habits in different mines and may also throw some light on growth mechanism. With this in view twenty-four dodecahedron diamonds have been examined.

On the natural dodecahedral faces of diamonds, four types of microstructures are commonly observed, viz., (i) striations, (ii) Rectilinear etch lines, (iii) irregular network and (iv) Parallelogram network. Emara and Tolansky (1957), Pandeya (1959) have shown with the help of precision multiple beam interferometry that the rectilinear etch lines and the irregular and parallelogram network principally arise through natural solution and the striations appear to owe their existence due to oscillatory growth.

A rare type of circular feature has been observed on three diamonds. These remarkable circular patterns of extremely rare occurrence consist of slightly raised circular discs, single or multiple, usually placed eccentrically one over the other and often overlapping and intersecting each other. The most significant observations are summarised below :—

- (i) These circular patterns are present on all the faces examined but are in larger number on four neighbouring faces, viz., (110) (1T0) (1T0) and (10T) and the number of circles on each face is approximately 150.
- (ii) The diameter of these circles varies from 0.018 mm. to 0.385 mm. The average diameter of most of the circles is 0.21 mm. However the larger ones have their diameter lying between 1.02 mm. and 2.42 mm.

- (iii) The height of the discs also varies; the large arcs are never greater than 490 \AA . Quite a number of them range from 25 \AA to 250 \AA . But the height of steps of each multiple discs varies from 216 \AA to 2730 \AA and sometimes the overall height of the discs in a circular pattern is upto 6000 \AA . ($\text{\AA} = \text{Angstrom} = 10^{-8}\text{cm}$).
- (iv) Most of these circular discs are multiple and are eccentrically placed one over the other. Their topography reveals a slight depression in the middle but are elevated from the surroundings.
- (v) The circles (discs) intersect each other and are visible completely. The overlapping region is higher than the rest.
- (vi) Those discs which lie near the shorter diagonal of the rhombic face continue on either side of it.
- (vii) The nature of intersection in some circular patterns is such that it appears as if they emerge from the ends of a chord of the main circle.
- (viii) The circles seem to be displaced a little at the region where they intersect the other circles.

A number of explanations regarding their formation have been considered namely,

- (i) That they are percussion marks.
- (ii) That they have been formed due to internal explosion.
- (iii) That they have been nucleated by a "three dimensional growth mechanism"
- (iv) That they are due to the presence of liquid or gaseous bubbles on the surface while the solution was taking place everywhere excepting in the regions protected by the bubbles.

On the basis of experimental evidence of etching a Germanium crystal whose structure is similar to that of diamond it has been concluded that these circular features have been formed by the mechanism suggested in the last paragraph above.

It has therefore been concluded that the dodecahedral faces of diamonds are much more vulnerable to a solution process in nature than an octahedron face.

147 Determination of Crystal Structures of Diphenyl Sulphone, Tricyclohexylamine and Diphenyl Amine

G. B. MITRA, Kharagpur

With the help of oscillation and zero and first layer Weissenberg photographs, the unit cell dimensions and space groups of Diphenyl Sulphone, Tricyclohexylamine and Diphenyl Amine have been determined. For Diphenyl Sulphone $a = 11.74 \text{ A.U.}$, $b = 7.70 \text{ A.U.}$, $c = 11.35 \text{ A.U.}$, $\beta = 98^\circ$, $Z = 4$ and the space group is $P2_1/C$. For Tricyclohexyl Amine, $a = 9.65 \text{ A.U.}$, $b = 6.26 \text{ A.U.}$, $c = 16.60 \text{ A.U.}$, $\beta = 92^\circ$, $Z = 4$ and the space group is $P2_1/C$. For Diphenyl Amine $a = 10 \text{ A.U.}$, $b = 39 \text{ A.U.}$, $c = 10 \text{ A.U.}$, $\alpha = 90^\circ$, $\beta = 92^\circ$, $\gamma = 96^\circ$, $Z = 16$ and the space group is PT . Patterson and Sharpened Patterson plots of Diphenyl sulphone in both P_{00} as well as P_2 projections were not very informative and Sayre-Cochran-Zachariasen methods of sign fixing was used with the modification that structure factors of some intense three dimensional reflections were utilised in the calculations. This was done for both P_2 as well as P_{00} projections and resulting, Fourier maps were compared with the respective Patterson plots. After several trials, the R value in both the projections came

down to the order of 30% and by several cycles of least square refinements came to the order of 20%. Further refinement is being carried on. The same method was utilised for Triethylamine and the R values have come down to the order of 25% in both the projections. Further refinement is being carried on. Only Patterson projections for Diphenyl Amine has been carried out for the three sections and nothing much informative has yet been achieved.

148. Neutron Diffraction Methods in the Analysis of Crystal Structures

P. K. IYENGAR and R. RAMANNA, Bombay

Neutron diffraction methods and X-ray methods used in conjunction are now capable of giving information concerning solid state structure in regions where it was not possible previously. Due to the fortunate circumstance that thermal neutron spectrum in a nuclear reactor is peaked at neutron wavelengths between 1 and 2 Å, the analysis of crystal structures using neutron diffraction methods have become possible in all laboratories where reactors exist. Neutron diffraction methods have some advantages over the X-ray methods as described below but to get the complete information it is necessary to use, in most cases, both methods simultaneously. Since the neutron scattering amplitude of an element is not appreciably influenced by its atomic weight, light atoms particularly hydrogen, will be at no disadvantage in the presence of heavy ones. Thus the precise determination of hydrogen positions in organic compounds and in hydrated compounds, which is very difficult by X-ray diffraction methods, offers an immense field for neutron work. Secondly, it is found that the neutron scattering amplitude varies in seemingly arbitrary fashion from element to element and may be quite different for neighbouring elements, such as those of iron group of transition elements. Thus it is possible to distinguish between these elements in their compounds and alloys. Thirdly, magnetic moments can be detected and their magnitude and orientation determined in certain circumstances.

The techniques of neutron diffraction though similar to X-rays have certain unique features e.g., the size of a neutron diffraction apparatus is many times larger compared to an X-ray diffraction unit. The neutron diffraction apparatus designed and built at the Trombay Establishment is described. The equipment has been in operation for the past 6 months at Apsara. Some of the results obtained will be presented and the future programme planned with the C.I.R. reactor will be described.

149. The Crystal Structure of Cerium Complex of Tetrakis Dibenzoyl-methane

JAGDISH SHANKAR and N. R. KUNCHUR

CHEMISTRY DIVISION, Bombay

The crystal structure of cerium complex of tetrakis dibenzoyl methane has been examined from its (0 1 0) projection by two dimensional Fourier synthesis. The unit cell is orthorhombic with $a = 20.109 \text{ Å}$, $b = 10.320 \text{ Å}$ and $c = 23.514 \text{ Å}$. The space group is P_{cen} and the unit cell contains 4 molecules of the cerium complex. The coordination of the eight oxygen atoms round cerium has a square antiprismatic configuration.

150. Rotational Disorder in the Crystal Lattice of Cobalt^{III} Bis (Dimethyl Glyoximino) Diammine Nitrate. An X-ray investigation

K. S. VISWANATHAN and N. R. KUNCHUR, Bombay

The crystal structure of cobalt^{III} Bis (Dimethyl glyoximino) Diammine nitrate has been solved and refined by two-dimensional Fourier Synthesis. The Unit Cell is monoclinic with $a = 9.80 \text{ \AA}$, $b = 6.32 \text{ \AA}$, $c = 12.48 \text{ \AA}$, $\beta = 97^\circ$, Space group $= P2_1/C$; and $z = 2$.

The two Dimethyl glyoxime groups, linked to cobalt atom are in one plane and the two ammino groups are at right angles to this plane, giving an octahedral arrangement of atoms bonded to cobalt. There are two hydrogen bonds between the pairs of oxygen atoms.

The interesting feature of the structure is that the electron density projection down the 'b' axis, clearly shows that there is a free circular rotation of oxygen atoms of the nitrate groups around nitrogen. The plane of rotation of this group is almost perpendicular to the 'b' axis.

151. Crystal structure of Bis-acetylacetone Beryllium

V. AMIRTHALINGAM, V. M. PADMANABHAN and JAGDISH SHANKAR,
Bombay

The Crystal Structure of Bis Acetylacetone Beryllium has been determined by single-crystal X-ray diffraction. The crystals are monoclinic with $a = 13.49$, $b = 11.32$, $c = 7.76 \text{ \AA}$ and $B = 100.48^\circ$. There are four molecules per unit cell and the space group was fixed as $P2_1$ with two molecules forming one asymmetric unit. Inequality relations and trial and error methods were used to get the approximate structure and refinements were made by two dimensional Fourier summation. Oxygen coordination round beryllium is tetrahedral, and the acetylacetone radical is planar within experimental error.

152. Crystallographic Studies on Sodium Uranyl-8-quinolate, $\text{Na UO}_2 (\text{C}_9\text{H}_6\text{NO})_3$

V. AMIRTHALINGAM, Bombay

The unit cell dimensions of sodium uranyl-8-quinolate were determined by rotation and Weissenberg photographs; $a = 22.41$, $b = 14.42$, $c = 13.72 \text{ \AA}$ and $\beta = 98.30^\circ$. The density was found to be $\rho = 2.197 \text{ gm/cm}^3$ which fixes the number of molecules $z = 9$ in the unit cell. The space group was determined from systematic absences as $C_{2h}^{22} - C2/c$.

Uranium and sodium positions were found from Patterson projections and packing considerations and a preliminary Fourier projection on (ab) plane shows some details of the lighter atoms. Further work is in progress.

Instruments & Techniques

153. Instrumentation for Radiocarbon Dating

R. B. MUKHERJEE, A. NATH, N. GANGULY and A. M. GHOSE, Calcutta

A radiocarbon dating apparatus has been installed at the Bose Institute and is now ready for operation. The sample carbon is converted to CO_2 by either burning

it in an atmosphere of Oxygen (in the case of Organic samples) or by treating it with pure and dil. HCl acid (in the case of inorganic samples such as shells). CO_2 is then synthesized into C_2H_2 by chemical steps similar to those prescribed by Suggs. All the chemical steps from burning of carbon to acetylene synthesis are done in a single system (constructed here) under high vacuum ($\sim 10^{-3}$ mm. of Hg). Acetylene is counted by proportional and liquid scintillation counting techniques. The background counting is reduced by shielding with water tank built round it. The proportional counter is further in anticoincidence with a ring of twenty brass counters covering the main counter. For counting by the liquid scintillation technique acetylene is dissolved in the scintillating solution of toluene and dophenyl Oxazole at liquid CO_2 temperature. The anticoincidence brass counters and all the necessary electronic equipments for counting including a five channel pulse height analyzer have been constructed at the Bose Institute Laboratory and tested to run satisfactorily.

154. A 4π Scintillation β Counter for the Study of β Particles from Radio-nucleides obtained by $(n, 2n)$ Reaction.

BIMALENDU MITRA and B. GHOSE, Calcutta

A 4π Scintillation β counter has been developed for absolute counting of β particles from product radio-nucleides obtained by $(n, 2n)$ reaction. $(n, 2n)$ reactions are produced by 14 Mev neutrons generated in an artificial (T, d) source. The general characteristics of the absolute counter has been studied by counting .54 Mev β particles from a standard Sr^{90} foil. A Cu foil consisting of natural isotopes Cu^{63} and Cu^{65} has been irradiated with 14 Mev neutrons to obtain saturated activity and from activity determination of Cu^{62} in absolute 4π -counter, flux of neutrons has been determined. Yield obtained is 10^9 neutrons per sec. under operational condition of the accelerator.

155. Absolute Determination of I.C.C. in a Siegbahn-Slatis Spectrometer

P. N. MUKHERJEE and I. DUTTA, Calcutta

The possibility of an absolute determination of Internal Conversion Co-efficient is discussed, and the suitability of the Siegbahn Slatis Spectrometer is pointed out. The difficulties and the possible sources of errors are dealt with. Using same source and instrumental geometry the external and the internal conversion lines are measured for a number of radioisotopes.

156. Transistor Drive Circuits for Dekatrons

B. M. BANERJEE and K. S. PATEL, Calcutta

Transistor drive circuits have been described for GC 10/4B dekatrons by Chaplin and Kandiah (1.58). These apply paired pulses of 80 $\mu\text{sec.}$ duration and 80 volts amplitude to the dekatron guides and claim a resolving time of 300 microseconds.

A transistor circuit suitable for the faster GC10D dekatron, that attains a resolving time of $40\mu \text{ sec.}$, has been described by the authors. This supplies a $20\mu \text{ sec.}$ 150 volt pulse and is essentially a blocking oscillator pulser using a ferrite core transformer. The transformer design details have also been described. The circuit is simple and reliable and works over a supply voltage range of 7.5 volts to 18 volts. The current drain at a pulse rate of 5000 is only 2.0 mA at 12 volts. This is strikingly low when

one remembers that the current drain for a paired pulse drive circuit is 10 mA at a pulse rate of 500 only.

Following this, a similar circuit for GC10B, that needs 60μ sec. pulses, was developed. At 5000 pulse rate its current drain is 12 mA at 12 volts supply. This circuit also works over a range of 7.5 volts to 18 volts. It is essentially more simple and reliable compared to the paired pulse drive circuits and shows a resolving time ($200\ \mu\text{sec.}$) that is better than the manufactures figure for this dekatron.

157. Rapid Detection of Plutonium Aerosols using Annular Impactor

K. N. KIRTHI and P. KOTRAPPA, Bombay

An annular impactor is designed and fabricated to separate the aerosols of sizes above and below 0.1μ , which is equivalent to the separation of the long lived plutonium activity and short lived radon and thoron daughters activity. The collection efficiency obtained is about 90% for plutonium aerosols and about 10% for radon and thoron decay products. The shape of the sample being similar to that of the annular ring, as such a correction factor for the geometrical efficiency of the counter is arrived at. A technique for sampling air from the glove box is explained. A theoretical relation for the particle sizes and the corresponding collection efficiency is given.

158. A Low Temperature Assembly for X-ray Goniometer

P. SRIVASTAVA, Calcutta

A low temperature assembly, capable of taking Weissenberg photographs down to -160°C has been constructed. Its efficiency and economy have been discussed. Temperature control and the degree of reliability of the specimen temperature as measured by the Cu-constantan thermo-couple have been fully dealt with.

159. Etching of Calcite

N. S. PANDYA and J. R. PANDYA, Baroda

Optical and interferometric techniques are applied to study the etch patterns formed on rhombohedral cleavage surfaces of natural crystals of calcite which have been secured from Gujarat (Broach, Pavagarh & Chhotaudaipur) and Rajasthan. Several etchants, including inorganic, optically active and optically inactive organic acids, strong solutions of alkalis, fused sodium nitrate and potassium nitrate, and ammonium chloride solutions were used. In all cases two types of pits were observed:-- (1) flat bottomed pits and (2) point bottomed. The shapes of the pits are different for different etchants. The depth and orientation of the pits with reference to the percussion marks are determined. The two counterparts obtained by cleaving a crystal, were etched by the same and also by different etchants and were then matched and the correspondence of the pits and the cleavage lines in different cases is discussed.

160. Three Level Solid State Maser Amplifier.

PREM SWARUP, Allahabad

The present state of the three level solid state Maser amplifiers is reviewed. It is shown that the Gadolinium ($\text{Gd}_{0.05}\text{La}_{0.95}\text{Co}_{0.02}(\text{C}_2\text{H}_3\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}$) MASER offers

much less flexibility of the choice of the saturating and operating frequencies, while the Chromium⁺⁺⁺ ($K_3Cr_{.005}Co_{.995}(CN)_6$ or pink ruby $Al_2O_3 + 0.1\% Cr.$) MASER offers a full range of operating frequencies, and because of the long spin lattice relaxation time (0.02 second at 4.2°K) requires small power for creating the inversion of states. Cr^{+++} ion in the $K_3Cr(CN)_6$ forms the magnetic complex with the six surrounding cyanide groups. The splitting due to the crystalline field of cubic symmetry leaves an orbital singlet lowest state, which is further split into two Kramer's doublets by the field of lower symmetry and spin orbit coupling. The zeeman splitting of the lowest two doublets (with a zero field splitting of 5120 Mc/s) has been calculated and plotted at different crystal axes on the basis of the spin Hamiltonian :

$$\mathcal{H} = \beta g(H_x S_x + H_y S_y + H_z S_z) + D(S_z^2 - 5/4) + E(S_x^2 - S_y^2)$$

where $g = 1.992$, $D = 2.49$ Kmc and $E = 0.33$ Kmc.

A series of frequencies of interest in radioastronomy is tabulated together with the crystal orientation, magnetic field and pump frequencies for the corresponding Maser amplifier.

161. Some possible Arrangements of Parametric Amplifiers using lower Frequency Pumping

N. B. CHAKRAVARTI and K. D. DIKSHIT, Allahabad

An analysis of certain parametric amplifiers using lower frequency pumping is presented. Two cases, namely, lower frequency pumping parametric amplifier considered as (a) combination of a mixer and an amplifier using one pump and two idlers, and (b) combination of a mixer and an amplifier using two pumps and two idlers have been treated in detail. The phase and the power relations at signal frequency, pump and idling frequencies have been discussed. The expressions for negative resistance, gain, band-width and noise figure have been derived. It is shown that the noise figure can be reduced by choosing a small ratio of the pump frequency to idler frequency.

Two other possible cases, namely (c) combination of two mixers and an amplifier using two pumps and two idlers, and (d) combination of a mixer and two amplifiers using two pumps and three idlers have been discussed briefly. It is shown that the multi-idler circuits do not offer any added advantage and that the third case employing a combination of two mixers and an amplifier gives the best results with regard to gain.

162. Graphical Method for Determination of Thickness of Biological Samples

M. L. DE and P. SADHUKHAN, Calcutta

In a previous communication the effects of various parameters, as for example, the accelerating beam potential, density of the particular sample, photographic density, slope of the photographic plate etc., on contrast in an electron micrograph have been analysed and a simplified formula derived. This simplified formula relating mass thickness with image contrast has also been experimentally tested in case of a few biological samples. The present paper deals with a nomogram which is now drawn for quick determination of thickness of biological samples corresponding to any photo-

graphic density, accelerating beam potential, slope of the photographic plate and density of the particular sample. It has been found that for a particular biological sample when photographic density is 0.375 relative to background, beam potential is 60 K.V., slope of the Ilford Process photographic plate is 3 and density of the sample is 1, the thickness of a single membrane of the specimen is 325 Å.

163. Electron Microscopic Studies on Biomolecules.

S. N. CHATTERJEE and P. SADHUKHAN, Calcutta

The present report is a part of the detailed investigations undertaken by the authors on the direct visualisation of the individual molecules of proteins, and nucleic acids with the help of the electron microscope. This will allow to measure directly the molecular sizes and shapes and determine their agreements with the indirect deductions known at present. The next phase of the work will be to see the changes induced in the molecular level by the different treatment, e.g., (i) change in *pH* of the solution, (ii) dilution to different degrees, (iii) exposure to ultra-violet, X-rays and different nuclear radiations etc.

A detailed analysis of the limitations of seeing the biomolecules under a high resolution electron microscope has been presented in this communication. The analysis shows that the lack of contrast limits the ultimate size of a biomolecule which can still be resolved in an electron micrograph to about 120 Å. This shows the importance of adopting improved methods of specimen preparations to overcome the contrast limitations and see the molecules of still smaller sizes.

Preliminary results of this investigation started with the Desoxyribonucleic Acid have been presented here. The individual DNA molecules have been clearly seen as long fibres of 20 Å diameter. This is in good agreement with Hall's measurements and again confirms the Watson and Crick model. Another observation made here is the breaking up of the individual molecules to small fragments due to prolonged treatment with the alkali.

164. High Altitude Plastic Balloon Ascents and Stratospheric Winds over India

G. S. GOKHALE, M. G. K. MENON and R. T. REDKAR, Bombay

A large number of stratospheric plastic balloon ascents have been carried out in the Bombay-Hyderabad region; the largest of these balloons, of volume 0.9 million cubic feet, floated at an altitude of 115,000 ft. As a result of observations made on these flights, a number of improvements have been made in balloon production and flight techniques; these will be presented in this paper. Upper wind data obtained on these flights show the following broad patterns:

- (i) Westerlies in the 30-60 kilo feet region
- (ii) Easterlies in the 70-90 kilo feet region
- (iii) *Upper* Westerlies above 100 kilo feet.

The regions between these broad patterns are characterised by very low circling winds. The detailed features of these patterns in the premonsoon and postmonsoon periods are discussed.

A feasibility study will be presented of completely new balloon techniques for special purposes : carriages of loads of upto one ton, and flights of very long duration (upto 48 hours).

165. Production of Clipped Pulses of very short Period

S. C. PANCHOLI and N. K. SAHA, Delhi

A simple device is used to obtain clipped pulses of short period ($\sim 10^{-10}$ - 10^{-11} sec.) by mixing the anode and the tenth dynode pulses of an RCA-5819 photomultiplier tube. The single and the clipped pulses are photographed on a Tetronix 545 oscilloscope with 53/54K input unit and also studied on a diode bridge fast coincidence circuit.

SECTION OF CHEMISTRY

President :—A. K. BHATTACHARYYA,
D.Sc., F.R.I.C. (LOND.).

Abstracts

ANCIENT CHEMISTRY

1. Ancient Science

K. A. PATWARDHAN, Indore.

The Indian Culture, which is mainly based on ancient stream of thought, happens to be the oldest culture amongst the known cultures of the world, and its evolutionary history is available through the ancient texts. In these we distinctly see that the ancient sages were scientists of a very high calibre. An attempt has been made in this paper to prove this statement by taking a concrete case. We know today that Hydrogen and Oxygen combine to form water. A mantra from the Vayn Sukta of the Rigveda has been quoted which clearly shows that the Rishis of old knew that the combination of the two gases 'mitra' (Hydrogen) and 'Varuna' (Oxygen) form a liquid which can flow—water. In the end it has been suggested that, if an attempt is made to probe into these ancient texts in the light of modern sciences, it is likely to prove very useful for the advance of modern science helping humanity as a whole.

PHYSICAL CHEMISTRY

2. Studies in electrode of the Third Kind : Activity coefficients of Barium Chloride in Dilute Aqueous Solutions.

J. N. SAHAY, Ranchi.

The stability and reliability of the "electrodes of the third kind" have been investigated in some detail using the cell of the type :

$\text{Pb-Hg} / \text{PbCl}_2\text{O}_4, \text{BaCl}_2\text{O}_4 / \text{BaCl}_2 (m) / \text{AgCl-Ag}$ in which m was varied from 0.005 m to 0.10 m . The electrode reaction is : $\text{Pb} + \text{BaCl}_2\text{O}_4 \rightleftharpoons \text{PbCl}_2\text{O}_4 + \text{Ba}^{++} + 2\text{e}^-$, which behaves reversibly with respect to barium ions. The activity coefficient of barium chloride in aqueous solution at 25°C has been deduced from the E.M.F. measurements by the method reported earlier (Sahay, *Curr. Sci.*, 1959, 28, 148). The results obtained by the use of electrode of the third kind are in fair agreement with those found by other methods.

It is considered that for the satisfactory working of such an electrode the salts employed should be very slightly soluble and must not form any double compounds or mixed crystals. Reproducible potentials have been observed only in dilute solutions. The E.M.F. has a tendency to drift if oxygen free condition is not maintained showing oxidation at the surface of the amalgam.

2A. Kinetics of Oxidation of Ketones by persulphate ion.

KAILASH CHANDRA KHULBE and SATYA PRAKASH SRIVASTAVA,
Naini Tal.

A kinetic study of the Ag^+ catalysed as well as uncatalysed oxidation of acetone, by $\text{K}_2\text{S}_2\text{O}_8$ has been carried out. The reaction between potassium persulphate and acetone, both Ag^+ catalysed and uncatalysed, is unimolecular with respect to $\text{S}_2\text{O}_8^{2-}$ and zero-molecular with respect to acetone. The Ag^+ catalysed reaction shows a negative exponential salt effect. On the basis of these observations, which are similar to those for other Ag^+ catalysed redox reactions of $\text{S}_2\text{O}_8^{2-}$, a probable reaction mechanism for this reaction, on the lines of the general mechanism proposed by Srivastava and Ghosh for the Ag^+ catalysed oxidation reactions of persulphate ion, has been proposed. For the uncatalysed reaction, a negative salt effect is observed, but the exact nature of this negative salt effect could not be ascertained.

3. Conductivity of mixtures of phenol and alkalis.

B. R. GUHA, B. P. GYANI and MISS R. MISRA, Patna.

Conductivities of mixtures of phenol with NaOH and ammonia have been measured. Theoretical considerations show that it is possible to titrate phenol with NaOH but not with ammonia in aqueous solutions unless complex formation takes place. Experimentally, an approximate titration of moderately conc. solutions of phenol with N/1 NH_4OH may be carried out, the accurate extrapolation being difficult. It was concluded that there was no evidence, whatever, of complex formation between ammonia and phenol. The titration of phenol with NaOH may be carried out with tolerable accuracy in both directions at least with moderately concentrated phenol. The end point is located more satisfactorily when some NaCl is present in the titration with NaOH.

4. Estimation of p-Nitrophenol with Alkalis by Conductometric Titration.

B. R. GUHA and B. P. GYANI, Patna.

p-Nitrophenol ($K_a \approx 7.0 \times 10^{-4}$) is a weak acid but may be accurately titrated conductometrically with NaOH though not with NH_4OH . The reverse titration with nitrophenol in the burette is not satisfactory with NaOH in the cell, but is quite accurate with NH_4OH . The presence of NaCl or KCl does not affect the results. When NH_4Cl is present, the first break indicates the completion of titration of nitrophenol and second that of NH_4Cl .

5. Conductometric Titrations of Resorcinol with Alkalis.

B. R. GUHA and B. P. GYANI, Patna.

The first inflexion in the titration of 0.200 N Resorcinol with 1.0 N NaOH is not distinct and shows a high value. The final inflexion is both more definite and accurate. Small amounts of NaCl or KCl when present do not affect these results but NH_4Cl lowers the value both for the first and second inflexion in the titration with NaOH even when the added NH_4Cl is regarded as having been simultaneously titrated. With resorcinol in the burette, the results are equally insignificant.

6. Conductometric estimation of alkalis with acetic acid.

B. P. GYANI and Miss R. MISRA, Patna.

Conductometric titration of acetic acid with alkalis is quite a satisfactory procedure. But when sodium hydroxide or ammonia is taken in the cell, the results are not satisfactory. When the initial concentration of NaOH is about N/10 and the acid is N/1, the first portion of the titration graph is far from a straight line, and extrapolation is difficult. With N/50 NaOH the graph becomes straight and extrapolation is easy. The neutral point observed is about 15 per cent less in the former case and improves in the latter. With N/10 or N/50 ammonia in the cell, the first portion is straight, but the error remains similar. The concluding portion corresponding to excess acetic acid added is always straight. At the end point the graph becomes rounded possibly due to hydrolysis. If the end point of the hydrolysis graph is taken as the neutral point, results with an accuracy of 2 per cent or better may be obtained.

7. Conductometric titration of Polybasic acids with Sodium hydroxide and ammonia.

B. P. GYANI and MISS R. MISRA, Patna.

In the titration of N/50 oxalic acid with N/1 ammonia both the inflexions may be correctly obtained. With N/1 NaOH the second inflexion is not easily located. The conductivity falls at first due to removal of H^+ ions and after the first inflexion it rises due to increased dissociation consequent upon removal of the fully ionizable second hydrogen. With succinic acid the conductivity increases steadily from the commencement and a break corresponding to the final inflexion alone is obtained (NaOH or NH_4OH). When one starts with NaOH in the cell, a basic salt containing double the proportion of alkali required for a normal salt is indicated very clearly in each case (oxalic, succinic, citric), followed by an inflexion for the normal salt which is distinct only in the case of oxalic acid. On further addition of oxalic acid the conductivity increases, but there is no inflexion corresponding to acid oxalate.

8. Physico Chemical Studies of Anthranilic Acid-4. Studies on hydrogen bonding.

N. A. RAMAIAH and R. NATARAJAN, Kanpur.

To account for the concentration—variation of the dissociation constant (k) of a weak acid due to hydrogen bonding the following equation has been derived :

$$\log K = 2\Delta\sqrt{ac} - \log K_0 - B(1-\alpha)C \text{ where } B \text{ is related to dimerisation constant } L, \\ B = 2(0.4343) L; K_0 \text{ is the thermodynamic dissociation constant of the acid. This}$$

equation was found helpful in elucidating the variation of k of anthranilic acid with C at $30^\circ \pm 0.1^\circ C$. The data gave a value of 19.7 for L . K_0 was 0.97×10^{-5} .

9 Polarographic Determination of Rate Constant of Irreversible Reduction of Murexide.

N. A. RAMAIAH and R. K. CHATURVEDI, Kanpur.

Murexide or ammonium purpurate is known to be reducible at d.m.e. with Et_3 at -0.38 volts vs. S.C.F. Further, the reduction is irreversible in nature. The authors' conductometric data on the diffusion coefficient of purpurate ion was

employed to obtain the number of electrons (n) involved in the irreversible reduction of murexide at d.m.e.; n was equivalent to two. The rate constant k of the electrode process was computed corresponding to different values of applied potential; thus for example at 25°C, k was 4.07×10^{-4} at $E = -0.35V$. These data were employed for calculation of transfer coefficient (α) of the irreversible reduction of murexide at d.m.e.; $\alpha = 0.16$.

10. Conductometric Studies on Murexide.

N. A. RAMAIAH and R. K. CHATURVEDI, Kanpur.

Murexide or ammonium purpurate is an important metal ion indicator. The conductance of murexide solutions of varied concentrations (C) were measured at 30°C. By application of extrapolation methods applicable to systems involving ion-association the value of the equivalent conductance of free ions (Λ') corresponding to different concentrations was obtained. From these data the degree of dissociation and thermodynamic dissociation constant (K) of ammonium purpurate was computed ($pK = 1.56 \pm 0.03$). By plotting Λ' values against corresponding value of C the value of Λ'_0 is obtained. Application of Kohlrausch law gave 38.12 mhos. cm^2 as the ionic mobility (λ_0) for purpurate ion. From this value the diffusion coefficient (D) and ion-size (r) of purpurate ion were computed.

$D = 1.03 \times 10^{-5}$ and $r = 3.88 \text{ \AA}^0$.

11. Spectrophotometric Determination of Dissociation Constant of α -Nitroso β -Naphthol in aqueous solution.

N. A. RAMAIAH and K. S. TIWARI, Kanpur

The absorption spectrum of aqueous solution of α nitroso β naphthol, (α - β) II, was studied in the ultra violet and visible regions using Beckman DU spectrophotometer. (α - β) II exhibits absorption maxima at $\lambda = 260$ and $380 \text{ m}\mu$; at both these wavelengths Beer's Law was applicable. Absorption at $\lambda = 380 \text{ m}\mu$ varied markedly with pH. The classical dissociation constant k calculated from the absorption data did not remain constant at different pH. The existence of hydrogen bonding leading to the dimerisation of (α - β) II was examined; the dimerisation constant (L) was computed from the data on the variation of K with pH. Remarkably enough, L acquired negative value indicating that presumably (α - β) II exists in the dimer condition in the solid state and monomerises in the solution phase.

12. Physico Chemical Studies of Anthranilic Acid-1. Polarographic determination of dissociation constant.

N. A. RAMAIAH and R. NATARAJAN, Kanpur.

The polarograms of anthranilic acid (I) at dropping mercury electrode (d.m.e.) in varied supporting electrolytes such as KCl, KBr, NaCl, NaBr, $N(CH_3)_4$ Cl etc., were recorded on a manual polarograph ($m = 2.606 \text{ mg/sec.}$; $t = 3.15 \text{ Sec.}$). The half wave potential of I corresponded to $-1.62 \pm 0.02 \text{ volts Vs S.C.E.}$ The diffusion current constant was 1.39 and $E_{1/4} - E_{3/4} = 0.11 \text{ Volt}$ in 0.1 N $N(CH_3)_4$ Cl, indicating the irreversible nature of the reduction of the system at d.m.e. The values of i_d were concentration dependent. These when analysed according to the equation $i_d = a + b \log K$, gave the value of 1.076×10^{-5} ($pK : 4.97$) for dissociation constant K in accordance with the author's conductometric data ($pK : 4.93$ at 30°C; 4.98 at 25°C by Lunden).

13. Physico Chemical Studies of Anthranilic Acid-2 Determination of the diffusion Coefficient.

N. A. RAMAIAH and R. NATARAJAN, Kanpur.

The diffusion coefficient 'D' of anthranilic acid (I) which is required for computation of the number of electrons 'n' involved in the polarographic reduction process, and on which no data exist in literature, was investigated by conductance measurements. These last were made over a concentration range of 3 to 10 mM of sodium anthranilate, with a surfass conductivity Bridge ($30^{\circ} \pm 0.1^{\circ}\text{C}$). Analysis of the data by Davies' method gave $\lambda_0 = 31.6$ mhos for anthranilate ion and a value of $0.8541 \times 10^{-5} \text{ Cm}^2 \text{ Sec}^{-1}$ for D. Use of this value for polarographic data reported in the previous paper (Part I of this series) led to a value of unity for n of (I) indicating the reduction at d.m.e. of hydrogen ions controlled by the dissociation of (I).

14. Physico Chemical Studies of Anthranilic Acid-3. Computation of ionic radius of Anthranilate ion.

N. A. RAMAIAH and R. NATARAJAN, Kanpur.

The conductance data of sodium anthranilate at varied concentrations were employed for computing the ionic radius of the anthranilate ion (r). r_s , the Stokes law radius is given by the equation $r_s = \frac{F}{6\pi\eta_0 u}$ where $u = \frac{N}{10^7 F^2} \cdot \frac{\lambda_0}{z}$. Employing Robinson and Stokes' correction for the above (r_s), a value of 4.05 \AA was obtained for r .

15. Spectrophotometric Studies on Aluminium-Oxalate Complex.

A. PARTHASARATHY, D. RAMASWAMY and Y. NAYUDAMMA,
Madras.

The Aluminium-oxalate system was studied by its absorption behaviour in the u-v region. The complex gives a maximum at $259.5 \text{ m}\mu$ at pH values between 2 and 11. Beer's law was found to hold good for the complex (Potassium Trioxalato-aluminate) at 10^{-4} M to 10^{-2} M . The molar ratio of aluminium salt and oxalate to form the complex was found to be 1:3 both by Job's method as well as by slope ratio method. The application of method in calculation of instability constant of the complex and the limitations are discussed.

16. Role of H-ion in Thermal and Photochemical Oxidation of Glycerol with Potassium Dichromate.

K. K. ROHATGI, Calcutta.

The oxidation of glycerol ($c = 5.75 \text{ M}$) with potassium dichromate ($C = 0.124 \text{ M}$) has been studied in unbuffered solution and the behavior compared with that in a buffered solution of same pH value, (4.2). A solution of acetic acid-sodium acetate was used as the buffer. A prolonged visual observation of the reaction for over two months under two conditions showed that the unbuffered solution soon developed turbidity and the solution remained yellow, whereas the buffered solution changed to deep violet but remained transparent. In another set of experiment the pH of the reaction mixture was measured with progress of reaction by immersing the electrode system of Photovolt pH-meter in the solution. It was observed that the

rate of reaction was two to three times faster in the buffered solution whose pH remained constant than in the unbuffered solution whose pH increased from 4.2 to 4.55 after two hours.

Finally, the rates of thermal and photochemical reactions were studied under controlled conditions at two different temperatures, 25°C and 15°C. A 80W H.P. mercury discharge lamp with Wood's glass filter was used as the light source. The thermal rate was found to be more susceptible to the supply of H^+ than the photochemical rate. These results have been explained on the mechanism suggested by Westheimer et al, by Bowen and recently by Klaning. The increase in the thermal rate in the buffered solution does not seem to be due to the formation of acetyl chromic ion (Westheimer) but may be due to adequate supply of H^+ from the buffer.

17. A reaction between Iodine and Sodium thiosulphate in Heterogeneous liquid-liquid system in the presence of a Surface-active agent.

P. S. JAVADEKAR, Sangli.

The main object of the present investigation is to find out the effect of surface-active agents in heterogeneous liquid-liquid system. A reaction between Iodine solution in Chlorobenzene and aqueous Sodium thiosulphate or aqueous Sodium hydroxide has been studied in the present investigation. The velocity of a reaction in such a system is dependent on the concentration of the reactants at the interface. The interfacial tension is affected by Sodium hydroxide to a greater extent than Sodium thiosulphate. The rates of reaction at the interface were compared. The remarkable difference in the velocity constants when Sodium thiosulphate is replaced by Sodium hydroxide in aqueous phase clearly indicates that, in heterogeneous liquid-liquid system, sodium hydroxide, (a surface-active agent) changes the concentration of Iodine at the interface.

18. "Catalytic decomposition of potassium chlorate in the presence of a mixture of Catalysts and determination of the temperature coefficient of the decomposition".

L. M. APTE and P. S. JAVADEKAR, Sangli.

Mixtures of sulphate of chromium with those of (1) Iron (ferrous) and (2) Cobalt and (3) Vanadium chloride, as catalysts, are used to decompose potassium chlorate and the reactions have been investigated. The mixture of catalysts, with chromium as one component, acts less effectively than the individual components of the mixture.

The temperature coefficients of the decomposition have also been determined.

19. Kinetics of Hydrogen Chemisorption on Ni-MgO Catalysts.

LOURDU M. YEDDANAPALLI and N. RAMASUBRAMANIAN, Madras.

The kinetics of chemisorption of hydrogen on nickel dispersed in magnesia catalysts with varying nickel content was studied at different temperatures and the 'Flovich equation' was used to analyse the experimental data.

The Flovich plots showed breaks whose direction was a function of the temperature. An intermediate temperature T was found at which the plot appeared to be a straight line. The parameters α_1 , α_2 and $-\log t_{01}$ varied abnormally up to T_1 whereas above T_1 the variation was normal. The behaviour of α_1 was just the

opposite. The activation energy of adsorption increased with increasing magnesia content of the catalysts.

This is the first instance where the variation of the Elovich parameters of the two parts of the plot with a break and also the change in direction of the break with temperature are reported.

The occurrence of break in the Elovich plots is attributed to oxygen impurities present as unreduced nickel in the catalysts and the change in direction of the break is explained in terms of the potential energy diagram. Explanation is offered in terms of a change in the ionised bond type viz., from $M+X^-$ at low temperatures to $M-X^+$ at high temperatures for the anomalous variation of the Elovich parameters.

20. Freezing points of Dilute Solutions of Aliphatic Monocarboxylates of Bivalent Metals and their Dissociation.

S. N. BANERJEE, Bombay and S. K. SIDDHANTA, Kharagpur.

The aliphatic monocarboxylates of bivalent metals dissociate in aqueous solution as,



In the present paper studies on the freezing point depression of dilute solutions of lead acetate, lead propionate and manganese acetate have been performed, and the data obtained have been utilised to test the values of the dissociation constants of the above salts, determined by us and by others, (Jour. Ind. Chem. Soc., **35**, 1958, 338, 419; **32**, 1955, 234; **30**, 1953, 213) assuming mass action constants to be equal to the respective thermodynamic constants; and the orders of the constants have been well verified.

21. Thermometric studies on the composition of mercurous thiosulphate complexes.

M. S. BHADRAVER.

Attempts have been made in this paper to investigate the composition of mercurous thiosulphate complexes by applying the method of thermometric titrations.

Using different concentrations of the reactants (mercurous nitrate and sodium thiosulphate), thermometric titrations were carried out both by direct and reverse methods.

The direct thermometric titration curves suggest the formation of the complex $Na_2Hg_2(S_2O_3)_3$ and $Hg_2S_2O_3$. The reverse titration curves yield only one break corresponding to the formation of $Hg_2S_2O_3$. In aqueous medium the observed titre values slightly differ from the theoretically calculated values but in alcoholic medium there is fair coincidence between the calculated and observed values. The method can be used for the quantitative estimation of mercurous in solution.

22. Electrometric studies on the composition of Cupric arsenite complexes.

M. S. BHADRAVER, Churu.

The complexes cupric arsenites, studied by conductometric measurements at several concentrations of the reactants both by direct and reverse methods yield only one distinct break corresponding to the formation of $CuHAsO_3$. But in direct and reverse potentiometric titrations, the diagrams yield one break corresponding to the formation of $Cu(AsO_3)_2$.

23. Thermometric studies on the composition of mercuric thiosulphate complexes.

M. S. BHADRAVER, Churu.

The formation and composition of mercuric thiosulphate complexes have been studied by thermometric measurements involving thermometric titrations between mercuric nitrate and sodium thiosulphate at several concentration of the reactants both by direct and reverse titrations.

Using different concentrations of the reactants mercuric nitrate and sodium thiosulphate thermometric titrations were carried out both by direct and reverse methods.

The direct thermometric titration curves yield one break corresponding to the formation of the complex $\text{Na.Hg}_2(\text{S}_2\text{O}_4)_2$. The reverse titration curves suggest the formation of the complexes HgS_2O_3 and $\text{Na}_2\text{Hg}_2(\text{S}_2\text{O}_4)_3$.

24. Thermometric studies on the composition of silver arsenite complexes.

M. S. BHADRAVER, Churu.

The formation and composition of silver arsenite complex has been studied by the thermometric measurements involving thermometric titrations between silver nitrate and sodium arsenite) at several concentrations of the reactants both by direct and reverse methods. The direct and reverse thermometric titration curves yield one break corresponding to the formation of the complex Ag_3AsO_3 .

25. Thermometric and potentiometric studies on the composition of complex arsenate of copper.

M. S. BHADRAVER, Churu.

The formation and composition of copper arsenate complexes has been studied by thermometric and conductometric methods. The direct and reverse thermometric and conductometric titration curves yield one break corresponding to the formation of CuHAsO_4 . The mechanism of the reaction has also been suggested.

**26. Physico-Chemical studies on the Composition of Arsenates of Metals :—
Part XII—Thermometric studies on the composition of nickel arsenate complexes.**

M S BHADRAVER, Churu.

The composition of nickel arsenate has been studied by the thermometric method involving thermometric titrations between nickel sulphate and sodium hydrogen-arsenate at several concentration of the reactants both by direct and reverse methods. The direct thermometric titration curves suggest the formation of NiHAsO_4 . The reverse thermometric titration curves yield three breaks corresponding to the formation of the complexes NiHAsO_4 , $\text{NiNa}_2(\text{HAsO}_4)_2$ and $\text{NiNa}_4(\text{HAsO}_4)_4$.

27. Physico-Chemical Studies on some Cerous complexes—Part I Determination of their conductance.

R. L. MITAL, and P. C. VYAS, Jaipur.

The conductance of a few cerous complexes (prepared by the interaction of anhydrous Cerous Chloride with pyridinium hydrochloride in Methyl alcohol, ethyl

alcohol, amyl-alcohol and benzyl alcoholic media and separating the respective complexes with the help of dry ether) at different dilutions (λ_{32} to λ_{1024}) was measured.

The conductivity (λ_{1024}) of the complex having the composition $\text{Ce Cl}_3 \cdot \text{C}_5 \text{H}_8 \text{NH Cl} \cdot \text{C}_6 \text{H}_5 \text{CH}_2 \text{OH}$, is found to be 480 mhos (at 20°C). It corresponds to five ions, one Ce^{+++} and four Cl^- ions. λ_{1024} of the other complexes, prepared in other alcohols and having compositions such as $\text{Ce Cl}_3 \cdot \text{C}_5 \text{H}_8 \text{NH Cl} \cdot \text{CH}_3 \text{OH}$; $\text{Ce Cl}_3 \cdot \text{C}_5 \text{H}_8 \text{NH Cl} \cdot \text{C}_2 \text{H}_5 \text{OH}$ and $\text{Ce Cl}_3 \cdot \text{C}_5 \text{H}_8 \text{NH Cl} \cdot \text{C}_5 \text{H}_{11} \text{OH}$, varies from 640 to 660 mhos. Suggestions to account for the higher values of λ_{1024} of these complexes have been attempted.

28. Physico-Chemical studies on some cerous complexes—Their magnetic moments.

R. L. MITAL, Jaipur.

The magnetic moment of some cerous complexes has been determined and their experimental values are reported as follows :—

S. No.	Substance	($\mu\beta$ effective)
1.	$\text{Ce Cl}_3 \cdot \text{C}_5 \text{H}_8 \text{NH Cl} \cdot \text{CH}_3 \text{OH}$	2.50 (30°C)
2.	$\text{Ce Cl}_3 \cdot \text{C}_5 \text{H}_8 \text{NH Cl} \cdot \text{C}_2 \text{H}_5 \text{OH}$	2.53 (29.8°C)
3.	$\text{Ce Cl}_3 \cdot \text{C}_5 \text{H}_8 \text{NH Cl} \cdot \text{C}_5 \text{H}_{11} \text{OH}$	2.56 (30°C)
4.	$\text{Ce Cl}_3 \cdot \text{C}_5 \text{H}_8 \text{NH Cl} \cdot \text{C}_6 \text{H}_5 \text{CH}_2 \text{OH}$	2.62 (30°C)

It is found that in the compounds No. 1 to 4, the effective magnetic moment varies from 2.50 to 2.62 B.M.

From the magnetic results the nature of the bond, by which the complexes are built up, has been revealed.

29. High Frequency Titration of Mercaptans.

(Miss) BANYA ROY, KANAI LAL MALLIK and S. N. MUKHERJEE, Calcutta.

High frequency titration method has been extended to the estimation of mercaptans in very dilute solution by titration with iodine solution. Benzyl mercaptan and thioglycolic acid have been successfully titrated with the H.F. titration apparatus utilising the frequency of 6.47 megacycles per sec. The circuit of this apparatus is a modification of that proposed by Hall or Jensen and Parrack (Ind. Eng. Chem. Anal. Ed., 18, 595, 1946), the beaker containing the solution was placed in parallel with the capacitor circuit and not in the tank coil. This method is particularly advantageous for the estimations of mercaptans in very dilute solutions as well as in the coloured solutions where the visual titration of mercaptans by iodine solutions fails. The titrations were mostly carried out in alcoholic solutions.

30. A Theoretical study of bond angles of simple molecules.

C. S. SHARMA, Patna.

From a theoretical consideration of interaction of bonds on each other in molecules of types AX_3 and AX_2 , where three or two similar atoms are linked to a central atom apparently by utilization of its three or two p-orbitals respectively, it has been possible to state the following rules governing deviations of bond angles from the ideal Pauling-Slater value of 90° in simple molecules.

Rule 1. Greater electronegativity of the central atom, compared to electronegativities of atoms bonded to it, tends to increase the deviation.

Rule 2. Shorter bond-lengths tend to increase the deviation.

Rule 3. When bond angles are anomalous with respect to Rules 1 & 2, the abnormal bond-angles are caused by steric factors, and molecules involving these abnormal bond angles are unstable, as the overlappings of bond-orbitals are far from maximum in these cases.

Bond angles of NH_3 , PH_3 , AsH_3 , PCl_3 , PBr_3 , FI_3 , H_2O , H_2S , F_2O and Cl_2O have been found to be in accord with these rules.

A detailed communication on the subject is under preparation.

31. The behaviour of electrolytes in mixed solvents : Viscosity of Potassium Nitrates in dioxane-water mixtures at 35°C.

P. K. DAS, Cuttack & Sundergarh.

The present investigation comprises of a study of the viscosity of Potassium Nitrate solutions in solvents containing 10, 20 and 30 per cent of dioxane-water mixtures. In solvents of low dioxane content the Jones Dole equation is obeyed, but at higher percentage of dioxane, the modified form of the Jones Dole equation : $\eta/\eta_0 = 1 + A\sqrt{C} + BC^2$ holds good. The nature of B has been investigated and is found to depend not only on the composition of the solvent, but also on the specific properties of the constituent ions of the electrolyte.

32. Application of the Modified Oswald Basicity Rule to some non-aqueous Solutions.

RAM GOPAL and S. B. MISRA, Lucknow.

Electrical conductance data for a few sodium salts of mono-basic acids in three solvents viz., formamide, N-methyl formamide, and N-methyl acetamide have been examined from the point of view of a modified form of the old Ostwald basicity rule ($\lambda_{1024} - \lambda_{32} = 10.8 \times b$), or $\lambda_0 - \lambda_{0.01} = 8.3 \times b$ (b denotes basicity) which is valid for aqueous solutions. This modification has been recently suggested on very reasonable grounds by Ganguli and Rakshit (J. Indian Chem. Soc., 1959, 36, 13). The value of the constant multiplier has been found to be rather small (ca. 1.5 for formamide, 1.2 for N-methyl acetamide and 2.3 for N-methyl formamide) as compared to 8.3 for aqueous solutions. This suggests rather a small effect of the ionic atmosphere on the movement of ions in these solvents presumably due to their high dielectric constants. The modified rule fits in quite well in the case of the mono-basic acids examined here.

33. The Bright Platinum Electrode, II.

B. P. GYANI and RAM KISHORE PRASAD, Patna.

The bright platinum electrode has been treated in a number of ways (These abstracts, 1959, 92) and its behaviour towards producing stable potentials has been studied. It appears from these experiments that the metal functions as an oxygen electrode, $\text{O}_2 + 2e \rightleftharpoons \text{O}^{--}$, $\text{O}^{--} + \text{H}^+ \rightleftharpoons \text{OH}^-$, and hence only indirectly as a hydrogen electrode. The slope of the EMF-pH graph at room temperature is 0.059 which of course is equally reconcilable to its functions as an oxygen as well as hydrogen electrode. It has been pointed out that there may be more than one equilibrium trying to assert itself at the electrode and one of these may preponderate in an experimental sense depending upon experimental conditions. This situation raises the difficulty of defining a standard potential for the electrode in a given titration

and points out that the same may not remain quite steady. However, in many cases already studied it is steady enough for quite accurate results.

34. Electrolysis of Potassium and Ammonium Thiocyanate Solutions at Different Temperatures.

B. P. GYANI and Miss R. MISRA, Patna.

Electrolysis of 5% KCNS and NH_4CNS solutions has been carried out at 0° , 25° and 80°C , at constant voltage in a U tube. The changes in the current strength and the concentrations of CNS^- ions in the anode and cathode compartments have been followed with time. These changes are quite different for the two solutions. There is a clear indication in the case of NH_4CNS that not all the CNS^- ions discharged at the anode are converted into a yellow precipitate or escape as a sulphur-containing gas. Some of the discharged ions are perhaps polymerised into a water-soluble product which may hydrolyse producing an acid. This explains the fact that there is a sharp fall in current during electrolysis, but the conductivity is more than regained on standing overnight.

35. Exchangeable Al-ions in Hydrogen-Clays.

MAHITOSH SARKAR and B. CHATTERJEE, Howrah.

Al-ions are liberated when a hydrogen-clay (H-clay) is treated with solutions of neutral salts. The presence of Al-ions in exchangeable form on the surface of H-clay particles has also been proved by a number of investigators. The potentiometric titration curves of H-clays with alkalies do not, however, show a buffering in the pH region of 3.5 and 4.5 as observed in the titration curves of solutions of aluminium salts. Doubts, have, therefore, been expressed as to the very existence of exchangeable Al-ions on the surface of H-clay particles. Fuller information on this point has been obtained by comparing the properties of a H-clay with those of the same clay after being converted into Al-clay. The base exchange capacity of the H-clay has been found to be equal to the amount of exchangeable Al-ions of the Al-clay showing that the hydrogen clay has been converted into Aluminium clay. The potentiometric titration curves of the two clays with KOH have been found to be similar and further, none of the curves shows a buffering in the pH region of 3.5 and 4.5. The argument put forward against the existence of exchangeable Al-ions on the surface of H-clay particles does not appear to be tenable.

36. Ester Mechanism of Oxidation of Primary and Secondary Alcohols by Chromic Acid.

A. C. CHATTERJI and SAMIR KUMAR MUKHERJEE, Lucknow.

When chromic anhydride is shaken with a solution of a secondary alcohol in benzene, CCl_4 , hexane, or ether, a yellow compound often forms in the non-aqueous layer due to the formation of chromate ester. We have isolated the chromic acid esters of n-propyl-, iso-propyl-, n-butyl-, iso-butyl-, sec-butyl-, and sec-hexyl-alcohols in benzene and CCl_4 layers.

An investigation of the oxidations of iso-propyl-, and sec-butyl-alcohols by chromic acid in pyridine-pyridinium ion buffer solutions reveals that pyridine catalyzes the reactions. At some concentrations the rates are increased by more than 30%. The rates were compared for the catalysis by perchloric acid and pyridine-pyridinium ion buffer solutions, at the same pH and ionic strength.

Consistent with all the facts a general mechanism, involving the chromic acid ester of alcohol, has been proposed.

37. Pyridine Catalysis of the Oxidation of Ethylene and Methylated Ethylene Glycols by Chromic Acid.

A. C. CHATTERJI and SAMIR KUMAR MUKHERJEE, Lucknow.

The oxidations of ethylene glycol, propylene glycol, and pinacol by chromic acid have been studied in pyridine-pyridinium ion buffer solutions at 35°C with an object to find out if the oxidations involve a base-initiated breakdown of the chromic acid ester intermediate.

Two important observations have been noted here : (a) A chromic acid ester of pinacol can be prepared in benzene solution but not in carbon tetrachloride, toluene, ether etc., in which pinacol is insoluble. No formation of chromic acid ester of ethylene glycol, propylene glycol, and 2:3 butylene glycol takes place in benzene, ether or carbon tetrachloride. In these solvents the above glycols are insoluble. (b) In aqueous solution pyridine, a proton acceptor, accelerates the oxidations of ethylene glycol and propylene glycol up to 40%. Pinacol, in the presence of pyridine, does not show any increase in the rate of oxidation.

The mechanism of glycol-splitting as well as the oxidation to aldehyde in the normal way has been discussed in the light of these facts.

38. Mechanism of Chromic Acid Oxidation of Formic Acid.

SAMIR KUMAR MUKHERJEE, Lucknow.

A kinetic investigation of the oxidation of formic acid with chromic acid in presence of perchloric acid has been made with wide variations of reactant concentrations at constant ionic strength. The reaction rate is dependent on the ionic strength. The order of the reaction with respect to chromic acid, formic acid, and hydrogen ions has been determined. Manganous and cerous ions retard the reaction by about 50%. BeSO_4 , ZnSO_4 , and CdSO_4 also retards the reaction. The induction factor for the induced oxidation of manganous sulphate to manganese dioxide has been found to be 0.5. This indicates that the Cr^{VI} ion is the active oxidant.

An evidence has been brought forward to show that the oxidation proceeds through the initial formation of formyl chromic anhydride as intermediate. A mechanism, involving a cyclic transition state, is proposed to account for these observations.

39. Temperature Dependence of the Rate of Chromic Acid Oxidation of Formic Acid : Arrhenius Frequency Factor and Thermodynamic Constants.

SAMIR KUMAR MUKHERJEE, Lucknow.

The rates of oxidation of formic acid by chromic acid in presence of perchloric acid were measured in duplicate at four temperatures with wide variations of reactant concentrations at constant ionic strength. The energy of activation, E , and the frequency factor, A , were calculated from the Arrhenius relationship, $k = A e^{-E/RT}$, by the method of least squares. The enthalpy, ΔH , and entropy, ΔS , of activation were obtained from the Eyring equation, $k' = \frac{kT}{h} e^{\Delta S/R} e^{-\Delta H/RT}$

by plotting $\log \frac{k'h}{RT}$ against $1/T$ and calculating the slope by the method of least squares. The free energy of activation, ΔG , was calculated from the values of ΔH and ΔS . An interpretation of the rate data and the thermodynamic constants is given.

40. Studies on Complex ion Formation in Lead Nitrate Graham's Salt System.

A. C. CHATTERJI and RAVI MOHAN BHATNAGAR, Lucknow.

Complex-ion formation in the system $Pb(NO_3)_2 \cdot H_2O - (NaPO_3)_n$ has been detected by three different methods: (a) By measuring the variation in pH during the titration of lead nitrate with various samples of Graham's salt and vice versa. (b) By determining the variation of specific conductance during the titrations of lead nitrate with Graham's salt; and (c) By finding out the conductivities of various equimolecular mixtures of lead nitrate and Graham's salt according to the Job's method of continued variation.

In all these methods four samples of Graham's salt of different weight-average molecular weight, ranging from 6,300 to 13,000, have been used. In every sample a complex in the ratio of one molecule of lead nitrate to three units of $NaPO_3$ has been obtained by all the three methods used here. An attempt has been made to explain the pH and conductivity changes with respect to the structure of the complex formed.

41. Studies on Polymetaphosphate Complexes. Part II. System : $BaCl_2 - (NaPO_3)_n - H_2O$.

A. C. CHATTERJI and RAVI MOHAN BHATNAGAR, Lucknow.

The complex ion formation in the system: $BaCl_2 - (NaPO_3)_n - H_2O$ has been detected by three different methods, as given in the previous paper. In all these methods five samples of Graham's salt of different weight-average molecular weight, ranging from 6300 to 13000, have been used. In this system two complexes in the ratio of 1 Ba ion to 2 $NaPO_3$ unit and 1 Ba ion to 4 $NaPO_3$ unit, have been detected. The complex formed at the ratio 1 : 2 is more stable as it could be detected by all the three methods used, whereas 1 : 4 complex has been detected in pH and conductometric titrations of $BaCl_2$ with normal and molar solutions of various samples of Graham's salt only. By Job's method of continued variation only one complex at the ratio of 1 Ba ion to 2 $NaPO_3$ unit has been detected. Thus it is more stable than the complex formed at the ratio 1 Ba ion to 4 $NaPO_3$ unit. A plausible mechanism of the reaction has been discussed and a structure of the complex has been proposed.

42. Studies on Polymetaphosphate Complexes : Part I. System— $AgNO_3 - (NaPO_3)_n - H_2O$.

A. C. CHATTERJI and RAVI MOHAN BHATNAGAR, Lucknow.

The complex ion formation in the system $AgNO_3 - (NaPO_3)_n$ has been studied in detail by measuring conductivity and pH changes. In pH titrations seven samples of Graham's salt of different weight average molecular weight, ranging from 5,000 to 15,500, have been used. Two complexes at the ratio of 1 Ag^+ to 1 $NaPO_3$ unit and 1 Ag^+ to 2 $NaPO_3$ units have been detected in all the pH titrations. Conductometric titrations have been carried out with 5 samples of Graham's salt at two concentrations of silver nitrate. At lower concentration of $AgNO_3$ only one complex at the ratio of 1 : 2 could be detected. At higher concentrations of silver nitrate two breaks at the ratio 1 : 1 and 1 : 2 have been obtained.

The Job's method of continued variation has been used to determine the composition of the complex with two different samples of Graham's salt. A peak at the ratio of 1 Ag^+ to 1 $NaPO_3$ unit has been obtained. An interpretation of the data is given and a structure of the complex has been suggested.

43. Graham's Salt; A Note on the Relation Between the Weight-average Molecular Weight and the Endgroup Molecular Weight.

A. C. CHATTERJI and H. N. BHARGAVA, Lucknow.

The weight-average and the endgroup molecular weights of nearly sixty samples of Graham's salt were determined in order to find out the relation between the two kinds of molecular weight in the case of this polyelectrolyte. No definite relation could be obtained between the two values although in a large number of cases the endgroup molecular weight was found to be nearly one-half of the weight-average molecular weight.

44. Studies in Inorganic Polyelectrolytes—Part III. Conductivity Behaviour of the Aqueous Solutions of Condensed Phosphates.

A. C. CHATTERJI and HARTHAR NATH BHARGAVA, Lucknow.

Conductivities of the aqueous solutions of nearly 30 samples of Graham's salt having weight-average molecular weights in the range of 3000-8000 have been observed. In all the cases a sharp curvature is observed in equivalent conductivity-concentration ($\Lambda - C^{1/2}$) curves obtained with these samples. At low concentrations the equivalent conductivity starts rising suddenly. The behaviour resembles that shown by weak electrolytes. The rise in equivalent conductance with decrease in concentration is more pronounced in the case of low-molecular-weight samples. In the case of high-molecular weight samples, the molecular weight dependence is much less conspicuous. Thus, on plotting equivalent conductance against weight-average molecular weight for any particular concentration of Graham's salt, curves have been obtained which show that with an increase in molecular weight, conductivity first falls sharply and then slowly. The effect of the weight-average molecular weight is more pronounced than that of the corresponding endgroup molecular weights, although the values of the latter too have been shown to effect the conductance.

The highly curved plots of Λ vs. $C^{1/2}$ could be reduced to linear ones on a log-log scale. A plot of specific conductivity against equivalent concentration is invariably linear.

The 'apparent basicity' obtained with the help of the Ostwald's rule is 3 for samples having the weight-average molecular weights in the range 3000-8000, and 2 for those having their weight-average molecular weights above 8000. There is a tendency for the value of basicity to increase with a decrease in molecular weight.

45. The Effect of Low-frequency Ultrasonic Waves on the Aqueous Solutions of Condensed Phosphates.

A. C. CHATTERJEE, H. N. BHARGAVA, K. K. TEWARI and P. S. KRISHNAN, Lucknow.

High-molecular sodium polymetaphosphate glass undergoes a true fission when its aqueous solutions are subjected to the action of ultrasonic waves of low frequency (25 kcs./sec.). There is a marked decrease in viscosity which is permanent. The endgroup molecular weight also undergoes diminution. The pII of the solutions increases at the end of the exposures. The fission of the macromolecule is attended by a slight increase in the conductivity of the solution. It would appear that low-molecular compounds are not formed in significant amounts as a result of irradiation. This is borne out by the fact that practically the same amount of phos-

phate dialyses out of the control and the irradiated solutions. Also, no significant amount of orthophosphate was found to be liberated from any of the condensed phosphates studied.

The rate of degradation of the polymetaphosphate increases with the increase in the weight-average molecular weight.

Pyro-, tri-, and tetra-phosphates, and tri- and tetra-meta-phosphates do not undergo any significant degradative changes during ultrasonic irradiation.

46. Formation of Mixed Liquid Crystals in Mixtures of Non-Liquid Crystalline Substances.

J. S. DAVE and J. M. LOHAR, Baroda.

Several binary systems have been studied wherein both the components are non-liquid crystalline substances by themselves. Of such binary systems, the mixture of p-anisal-p-phenetidine with p-nitrobenzal-p-phenetidine exhibits mesomorphism over a range of temperature and concentration (Authors, Chemistry and Industry, 597, 1959). The mixed liquid crystals of these non-liquid crystalline Schiff's bases in mixture with a liquid crystalline substance p-azoxyanisole are now studied. The transition line curves of these systems when extrapolated give latent transition temperatures, 120.0°C and 96.0°C for p-anisal-p-phenetidine and p-nitrobenzal-p-phenetidine respectively, which are identical with those obtained by extrapolation of the transition line curve of the binary system of these non-liquid crystalline substances.

The results indicate that mixed liquid crystals should normally be obtained from a binary non-liquid crystalline mixture if the melting points of the mixed melts fall below the hypothetical transition line joining the two latent transition temperatures. Nearer the latent transition temperature of the non-liquid crystalline component to its normal melting point, greater is the tendency for mixed liquid crystal formation in such binary mixtures.

47. Ionic Radii.

J. S. DAVE, B. R. PANCHAI, A. R. PATEL, and A. M. TALATI, Baroda.

An empirical relation has been established correlating the diamagnetic susceptibility of the cations having rare-gas electronic structure with the quantum numbers n and l , and the ionic charge (e). It is suggested that by the use of this relation, radii of the iso-electronic cations can be compared. Values of the radii for the multivalent positive ions are calculated using Pauling's values for the univalent radii of the univalent ions as standard values and these are compared with Pauling's univalent radii of multivalent ions.

48. Light Absorption during Mutual Coagulation.

N. V. KARBELKAR, Nagpur.

The kinetics of mutual coagulation have been followed by the study of the variation of light absorption by coagulating mixtures of oppositely charged hydrophobic sols using a sensitive photoelectric photometer. There is an immediate increase in light absorption followed by a nearly steady state. Immediately on mixing oppositely charged sols primary aggregates of higher scattering capacity are formed. Their secondary aggregation is a rate process. When the electrokinetic potential of primary sol-aggregates is low the rate of secondary aggregation

is faster. These final aggregates are more compact, denser and less hydrated and hence absorb more light. The rate of interaction of oppositely charged sols appear to be proportional to the product of the concentrations of interacting sols, $-\frac{dn}{dt}$ being proportional to n^2 . The coagulum catalyses the process giving autocatalytic character to progressive light absorption and the mutual coagulation process.

49. Coagulating Capacities of Mixtures of Negative Sols.

N. V. KARBELKAR and S. V. SOMAN.

An interesting parallelism between the electrolytic and mutual coagulation was discovered, such as acclimatisation and dilution effects. The mixtures of negative hydrophobic sols were generally more efficient coagulators than their component sols, more particularly when the component sols had widely different coagulating capacities. The mixtures of negative silver iodide and congo red sols show increased precipitating action on the positive ferric oxide sol above the additive relationship of the components, but the mixtures of arsenic and antimony sulphide sols were nearly as efficient as to be expected by the mixture law. The factors responsible for the superadditive coagulating capacity of mixtures of negative sols towards a positive sol has been discussed.

50. The Variation of the Electrokinetic Potential of Mixtures of Negative Hydrophobic Sols.

N. V. KARBELKAR and S. V. SOMAN, Nagpur.

The electrophoretic mobilities of the mixtures of negative hydrophobic sols have been investigated by the moving boundary method using a modified McLewis electrophoretic apparatus. The mixtures of arsenic sulphide and antimony sulphide sols showed distinctly lower electrophoretic mobilities than those calculated from the mixture law. The electrokinetic potentials of the mixtures of (i) prussian blue and arsenic sulphide sols, (ii) prussian blue and antimony sulphide sols, and (iii) vanadium pentoxide and arsenic sulphide sols were generally higher than their calculated values. The factors responsible for these deviations in the electrokinetic potential have been discussed.

51. Ultrasonic Velocity in Liquid Binary Mixtures.

S. K. K. JATKAR and M. V. KAULGUD, Poona.

The formulae of Eyring et al and of Kittel for the sound velocity in normal liquids cannot be applied to binary mixtures for want of a reliable method for calculating the free volume and the available volume. The empirical formula of Jacobson viz. $UL_f\rho^{1/2}=K$ can be used for this purpose since the definition of the free length L_f in the case of pure liquids can be extended to binary mixtures.

By substituting the ideal value of $\frac{1}{\rho_{mix}} \left(= \frac{W_1}{\rho_1} + \frac{W_2}{\rho_2} \right)$ in the free length formula

for binary mixtures viz.

$$L_{mix} = \frac{\left[\frac{1}{\rho_{mix}} - \left(\frac{W_1 V_{o_1}}{M_1} + \frac{W_2 V_{o_2}}{M_2} \right) \right]}{\left(\frac{W_1 Y_1}{M_1} + \frac{W_2 Y_2}{M_2} \right)}$$

the values of both $L_{mix:expt}$ and $L_{mix:ideal}$ can be calculated. The calculations in the case of ten binary systems reveal that the deviation from additivity of ultrasonic velocity depends upon whether $L_{mix:expt}$ is greater or less than $L_{mix:ideal}$.

52. Diffusion of Polyvalent Ions in Fused Electrolytes.

H. J. ARNIKAR and D. K. SHARMA, Varanasi.

The technique developed by one of us earlier (H.J.A.) for electromigration of fused alkali salts, has now been extended to the study of diffusion and self-diffusion of polyvalent ions (Sr^{++} and Y^{++}) in molten media of $NaNO_3 + KNO_3$, using radioactive isotopes Sr^{90} and Y^{90} (in equilibrium mixture) as tracers. The interesting finding is the partial separation of these two ions during diffusion in the molten phase which permits the calculation of their individual diffusion coefficients under the conditions of the experiment. These values are 10 and 4×10^{-6} $cm^2 \text{ sec}^{-1}$ for the Sr^{++} and Y^{++} ions respectively. Combined with our earlier results the order of diffusion appears to be $Na^+ > Sr^{++} > Y^{++}$. These results are explained in terms of relative degrees of dissociation of the salt and neutral ion-pair formation.

53. Ionic Diffusion in Aqueous Medium.

H. J. ARNIKAR and M. C. GEORGE, Varanasi.

The technique developed earlier by one of us (H.J.A.) for electromigration in agar-agar columns has been modified for studying diffusion of ions in aqueous medium. By virtue of its structure, the gel holds about 98% water in a semi-immobilised state wherein mixing due to convection is a minimum. This has been the basis of the present method for the measurement of mean diffusion coefficient of salts as well as self-diffusion coefficients of ions -the latter being studied with the help of radioisotopes as tracers. Results are presented for the mean diffusion coefficient of KCl, KBr and KI in 1N solution and Na_2HPO_4 in 0.5N and self-diffusion coefficient of HPO_4^{2-} in 0.05N Na_2HPO_4 studied with P^{32} .

54. Polarography of Dithiodimalic Acid.

S. K. TIWARI and R. C. KAPOOR.

Polarographic behaviour of Dithiodimalic acid has been studied at the dropping mercury electrode. The acid was prepared by the oxidation of thiomalic and with ferric alum in acidic medium.

In strongly acidic medium (Perchloric acid; pH 1.4) the acid gives a diffusion controlled cathodic wave indicating a 2 electron reduction of dithiodimalic acid.



At higher pH values the wave is progressively suppressed. The wave has a two third height in acetate buffer (Compared to perchloric acid solution). The current becomes negligible at pH 9.

55. Physico-chemical Studies on Mercury Complexes.

A. M. TALATI, Baroda.

The formation of the coordination compounds by mercuric nitrate with ortho-, meta-, and para-nitraniline has been investigated by the conductometric titration

method at $37.0 \pm 0.1^\circ\text{C}$. The results indicate the formation of the complexes $\text{Hg}(\text{A})(\text{NO}_3)_2$, $\text{Hg}(\text{A})_2(\text{NO}_3)_2$ and $\text{Hg}(\text{A})_4(\text{NO}_3)_2$ (where A is ortho- or para-nitraniline molecule), and $\text{Hg}(\text{A}')_2(\text{NO}_3)_2$ and $\text{Hg}(\text{A}')_4(\text{NO}_3)_2$ (where A' is a meta-nitraniline molecule). The results are discussed in terms of the coordination number of mercury and the effect of the substituent on the donor atom.

56. Negative Coherer Effect in Lead Dioxide Deposits.

H. N. VENKOBA RAO and A. VISWANATHAN, Karaikudi.

Negative coherer effect namely the phenomenon of decrease in the conductivity on the application of Hertzian waves has been observed for the first time in the case of lead dioxide deposits. This has been explained by the conversion of lead dioxide into lead monoxide by the high fields produced by Hertzian waves at the metal—lead dioxide contact surfaces.

The formation of the lead monoxide has been demonstrated by an electro-mechanical method of cutting lead dioxide deposits where a d.c. is applied for cutting the surface with the formation of a powder. This powder has been identified by X-ray powder diffraction method as lead monoxide thereby confirming the hypothesis of conversion of lead dioxide into lead monoxide.

57. Electrochemical Behaviour of Titanium in Alkaline Solutions. Part II : Potentiostatic Measurements.

INDRA SANGHI and S. VISVANATHAN, Karaikudi.

Efforts have been made to supplement our earlier galvanostatic studies of the electrochemical behaviour of titanium in alkaline solutions with the potentiostatic studies also. I-V curves have been plotted for titanium from -1.5 to $+2.5$ V with respect to $\text{Hg}/\text{HgO}/\text{KOH}$ system. It has been found that hydrogen is cathodically evolved between -1.5 to -0.8 V and the cathodic current rapidly falls in between from -1.5 to -1.2 V after which it is very small, of the order of a few microamps only. Titanium does not show any active dissolution region in alkaline solutions as is shown by cadmium, zinc and other metals. On the other hand, the current gradually becomes positive but remains very small, of the order of a few microamps, from -0.8 to $+0.8$ V in which region a thin coherent layer of titanium dioxide is presumably formed on the titanium anode, the current remaining almost constant in spite of the increasing potential. At $+0.8$ V the oxide layer has probably attained a thickness of $50\text{--}100 \text{ \AA}$ and a transition is observed when the current suddenly starts to rise again till another constant current plateau is observed from about $+1.8$ V to $+2.5$ V. In between $+0.8$ and $+1.8$ V minor complications are observed. These studies supplement and correlate the results reported by other workers and throw useful light on the electrochemical behaviour of titanium, which is discussed in this paper.

58. Criteria for Cathodic Protection.

K. S. RAJAGOPALAN and Y. V. P. RAMACHANDRA ROW, Karaikudi.

A number of criteria have been employed for determining when cathodic protection of metal structures is complete. Of these the most important are those based on the potential of the structure. On the basis of practical experience with pipelines, in particular, it is believed that if a steel structure is maintained at a potential of -0.77 V versus saturated calomel electrode it will be completely pro-

tected. This potential, it is believed, is also indicated by the observance of a change in the slope of the cathodic polarisation curve of the metal when the potential is plotted against applied cathodic current. Studies made in this laboratory on the potential at which cathodic protection is obtained by a newly developed technique involving the simultaneous application of a whole spectrum of current densities to the metal surface show that the potential at which complete protection is obtained can be very significantly influenced by the presence of inhibitive constituents in the corrosive media.

59. The Behaviour of Electrolytes in Mixed Solvent : Conductance of Magnesium Chloride and Potassium Sulphate in Dioxane-water Mixtures at 35°C.

P. B. DAS, P. K. DAS and D. PATNAIK.

The formation of ion-association or incomplete dissociation of electrolytes in solutions has been reported from the study of their conductance in various solvents (Harned and Owen "The Physical Chemistry of Electrolytes Solution", 2nd edition, page—147; James, J. Chem. Soc. 1951, p—153; Dunsmore & James, *ibid*, 1951, p—2925; and Griffith and Lawrence, *ibid*, p—1208). The conductance of $MgCl_2$, a bimonovalent salt and that of K_2SO_4 , a monobivalent electrolyte in 10, 20, and 30% dioxane-water mixtures has been measured at 35°C with a view to see the effects of the solvent composition on the diameter of the ion pairs $MgCl^+$ and KSO_4^- . The ionic diameters have been calculated by both Stokes and Bjerrum's method; the latter requiring the dissociation constants K_{MgCl^+} and $K_{KSO_4^-}$ have also been evaluated.

60. Viscosity of $MgCl_2$ and K_2SO_4 in Dioxane—Water Mixtures at 35°C.

P. B. DAS, P. K. DAS and D. PATNAIK.

The measurements of viscosity of $MgCl_2$ and K_2SO_4 in 10%, 20% and 30% by weights of dioxane-water mixture have been carried out to verify the modified Jones-Dole equation as suggested by us, (*Curr. Sci.* 1956, **25**, 337). The experimental data for 20% and 30% solvents fit in well with the modified equation, whereas for solvents containing 10% of dioxane the Jones-Dole equation as such is valid. The constant 'B' has been found to depend upon the composition of the solvent.

61. Thermodynamic Properties of Binary Mixtures of Benzene, Cyclohexane and Carbontetrachloride.

R. P. RASTOGI and R. K. NIGAM, Lucknow.

Phase-diagrams of carbontetrachloride-cyclohexane, benzene-cyclohexane and carbontetrachloride-benzene have been obtained by the method of thermal analysis. Mixtures of carbontetrachloride and cyclohexane show complete miscibility in the liquid phase and partial miscibility in the solid phase. The phase-diagram for benzene-cyclohexane belongs to an eutectic type. The equilibrium diagram of carbontetrachloride—benzene exhibits the formation of two compounds having the formula $C_6H_6 \cdot CCl_4$ and $C_6H_6 \cdot 2CCl_4$.

The thermodynamic analysis of the equilibrium data for the mixtures of carbontetrachloride and cyclohexane indicates the system to be a regular one. α and β which are related to interchange energies in the solid and liquid phase respectively are found to be dependent on temperature in the following manner

$$\text{Log}_{10} \alpha = 5.67 - 0.01114T$$

$$\text{Log}_{10} \beta = 5.73 - 0.01115T$$

It appears from the analysis that α and β increase enormously as the freezing point is approached. Guggenheim's analysis of the vapour pressure data for the system yields the value of α at 30°C to be 65.5 cal./mole whereas accordingly to present investigation this reaches 930 cal./mole at -30°C.

The system benzene-cyclohexane is very far from being regular in agreement with the Scatchard's finding based on the examination of vapour-liquid equilibrium data of the same mixture. This is due to the wide difference in the size and the shape of the two molecules.

62. Entropy production in the stationary state.

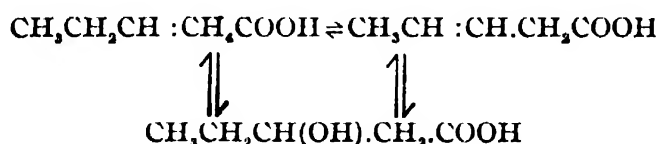
R. P. RASTOGI and R. C. SRIVASTAVA, Hoshiarpur.

According to the theorem of minimum entropy production, the stationary state is characterized by the minimum value of entropy production so long as the entropy production σ can be written as

$$\sigma = \sum J_i X_i$$

where X_i is the force and J_i is the flux and the linear relation between fluxes and forces are satisfied. For a more general case when the latter condition is not satisfied, Prigogine's new theorem states that in the stationary state, the function $m = -\sum J_i X_i$ where X_i is the time derivative of the force X_i , vanishes and is positive in all non-stationary situations.

In the present paper an experimental proof is given for the above theorem for a monomolecular reversible reaction viz., the isomerization of ammonium-thiocyanate into thiourea. The theorem is found to valid for the following monomolecular reversible triangular reaction also.



63. Studies in Collector Mechanism of Xanthates in the Flotation of Chalcopyrite: Contact Angle Measurements on Chalcopyrite Surface.

S. RAMACHANDRA RAO and C. C. PATEL, Bangalore-12.

Contact angle measurements, employing captive bubble, have been made on chalcopyrite mineral, conditioned with ethyl, isoprpyl, butyl and amyl xanthates in presence of oxygen, carbon dioxide and a mixture of the two gases. The studies were conducted both on unactivated mineral, as well as the mineral activated with cupric sulphate solution. It was found that the unactivated mineral did not show the characteristic angles of ethyl and isopropyl xanthates, but showed characteristic angles of butyl and amyl xanthates. In presence of oxygen, the contact angle gradually vanished in the case of ethyl xanthate, but no significant change was observed in the case of other xanthates. In presence of a mixture of oxygen and carbon dioxide and carbon dioxide alone, there was no significant change in the initial angle in all cases, except in the case of isopropyl xanthate, where the mineral gradually showed the characteristic angle of the xanthate.

When chalcopyrite was activated with cupric sulphate solution, the mineral showed characteristic contact angle in all xanthates. In presence of oxygen, the characteristic contact angles did not show any change in the case of ethyl and isopropyl xanthates. But in the case of butyl and amyl xanthates, the angles rose

and attained the values of corresponding dixanthogens. In presence of a mixture of oxygen and carbon dioxide, the contact angles rose and attained the values of corresponding dixanthogens in all cases, except that of ethyl xanthate. In presence of carbon dioxide alone, there was no appreciable change in the contact angles of ethyl and isopropyl xanthates; but in the case of butyl and amyl xanthates, the angles increased to some extent.

64. Electrodeposition of Cadmium-zinc Alloys from the Sulphamate Bath.

S. VENKATACHALAM and T. L. RAMA CHAR, Bangalore-12.

Cadmium and zinc have been codeposited from solutions containing cadmium and zinc sulphamates and caffeine. A detailed study has been made of the effect of the variables on plate composition, cathode efficiency and potentials. Cast alloy anodes are satisfactory. This bath gives good quality deposits over a wide composition range.

65. Anodic Corrosion of Nickel-Cobalt Alloys in Pyrophosphate Plating Solutions.

(Miss) VASANTA SREE and T. L. RAMA CHAR, Bangalore-12.

A study has been made of the behaviour of cast nickel-cobalt alloy anodes during the deposition of nickel-cobalt alloys from pyrophosphate solutions. Anode corrosion is fairly satisfactory as found from efficiency measurements, anode potential curves and analysis of plating solutions.

66. Corrosion Inhibition of Aluminium in Alkaline Solutions : Polarization Studies.

J. SUNDARARAJAN and T. L. RAMA CHAR, Bangalore-12.

The cathodic and anodic polarization of 99.5% aluminium in sodium hydroxide has been studied with and without dextrine inhibitor. The results indicate that the inhibitor action is predominantly on the anodic areas of the metal surface.

67. Potentiometric studies on the composition of Lanthanum ferrocyanide.

J. N. GAUR, Jaipur.

Potentiometric titrations between lanthanum chloride and potassium ferrocyanide have been done by using ferroferricyanide electrode in conjunction with a calomel electrode as a standard Cell. Solutions of varying concentrations were taken and from the titration curves, the amount of potassium ferrocyanide, reacting with a known volume of lanthanum chloride was noted and the composition of the complex was calculated.

The composition of the lanthanum ferrocyanide was also determined by adding excess of potassium ferrocyanide to lanthanum chloride solution of different concentrations. The excess of ferrocyanide was titrated against a standard solution of ceric sulphate. Both the potentiometric as well as volumetric methods gave the composition of the complex to be La/Fe(CN)_6 . This may be used as a method for the volumetric-estimation of lanthanum.

68. Study of Thiosalts—Part II : Conductometric Study of Mercuric Thiosalt.

K. P. DUBEY and S. GHOSH, Allahabad.

The conductometric study, of the formation of thiosalt of mercury has been made. It has been shown that the thiosalt hydrolyses and its hydrolysis constant has been calculated and found to be 0.6944. By further calculations the product of the two dissociation constants of the acid H_2HgS_2 has been calculated and the value obtained is 1.31×10^{-21} . This shows that the acid H_2HgS_2 is very weak but it is stronger than hydrogen sulphide whose product of the two dissociation constants is 1.092×10^{-22} .

69. Activation of Oxalate for its Reaction with Iodine.

H. L. KALRA and S. GHOSH, Allahabad.

The activity of ammonium oxalate as a reducing agent for iodine is considerably enhanced by the photo-reduction of a dilute solution of permanganate. To a solution of ammonium oxalate a dilute solution of potassium permanganate is added and exposed to sunlight. The solution after decolourisation is found to react more quickly with iodine solution in the diffused light than the oxalate solution not treated so, previously. It has been observed that

- (1) the activity is increased with increasing concentration of permanganate decolourised.
- (2) the activity is decreased with the increasing acidity of the oxalate by adding oxalic acid, and also by increasing concentration of potassium iodide in which the solution of iodine is prepared.

These results are similar to those observed in the reduction of mercuric chloride by an oxalate. It has been suggested that active species result in the oxalate solution, when potassium permanganate is reduced in excess of ammonium oxalate.

70. Magnetism of Cobaltic Complexes and the Ligand Field Theory.

S. S. DHARMATTI, C. R. KANEKAR and Miss S. V. NIPANKAR, Bombay.

Magnetic susceptibilities of a number of trivalent cobalt complexes measured by the Gouy's method indicate a substantial contribution of the second order paramagnetism of the cobalt atom, in all these complexes. It is further observed that this contribution decreases as the strength of the ligand field increases. These results find support in the ligand field theory. The observed values for the residual paramagnetism are of the same order of magnitude as those calculated on the basis of this theory.

71. Electron Paramagnetic Resonance Studies of Reaction of Tetraphenylhydrazine.

M. R. DAS, A. V. PATANKAR and B. VENKATARAMAN, Bombay.

The free radicals obtained from tetraphenylhydrazine, diphenylbenzidine and diphenylamine under different conditions have been investigated with electron paramagnetic resonance techniques. The three-line spectrum obtained from tetraphenylhydrazine in non-polar solvents, is attributed to the formation of the radical, diphenylnitrogen, $C_6H_5 \rangle \dot{N}$.

Five-line spectra are obtained from tetraphenylhydrazine, diphenylbenzidine and diphenylamine with a variety of reagents. All of them are not similar in their degree of resolution and measurements of g-values, line widths and hyperfine structure separations are expected to differentiate between them. It is, however, believed that the five-line structure is caused by free radicals having two adjoining equivalent nitrogen nuclei, such as in $\text{>}\ddot{\text{N}}-\ddot{\text{N}}\text{<}$. The use of deuterated acetic acid, CH_3COOD , has clearly demonstrated that the hyperfine structure is not due to the protons derived from the acid medium in those reactions where acids have been used.

The measurement of g-values, line widths and hyperfine structure separations are now in progress.

72. Charge and Stability of Colloids XXIV. To study the effect of temperature on the Kinetics of Coagulation of Sb_2S_3 Sol by electrolytes. Determination of temperature coefficient and thermodynamic constants.

B. P. YADAVA and MOHAMMAD YASEEN, Lucknow.

The effect of temperature on the Kinetics of coagulation of Sb_2S_3 sol. by coagulating ions of increasing valencies has been studied. The values of coagulation velocity constant and the bimolecular reaction constant have been observed at different temperatures with particular coagulating ion. The results so obtained give a comparative account of changes in the values of these constants. The temperature coefficients have been calculated by comparing the values of K at 25°C, 35°C and 45°C. An attempt has been made to calculate the energy of coagulation and thermodynamic constants with these observations. The changes in the conductivity and the viscosity of sols. have been determined, at different temperatures and compared with the above observations.

73. Charge and Stability of Colloids XXIII. Displacement of hydrogen ions from Sb_2S_3 sols by the addition of electrolytes in the presence as well as in the absence of non-electrolyte.

B. P. YADAVA and MOHAMMAD YASEEN, Lucknow.

The pH-metric titrations have been done with Sb_2S_3 sols and the consequent release of H^+ ions (counter ions) has been studied during the course of coagulation by the stepwise addition of Uni-, Bi, and Trivalent electrolytes. A relation between the coagulating powers of different electrolytes has been found out by comparing the amount of H^+ ion released at a particular concentration. Similar observations have been made to see the behaviour of the electrolytes in the presence of non-electrolytes i.e. agar-agar, gelatine and starch. The sensitising and stabilising tendencies of the non-electrolytes at different concentrations have been studied. The observations reveal that coagulating power is more remarkable as the valencies of the coagulating ions are increased, which leads to a proposed mechanism of the electrolyte coagulation.

74. Charge and Stability of Colloids XXV. To study the temperature coefficient and the energy of coagulation of colloids during the course of coagulation of chromium hydroxide at different temperatures by electrolytes of increasing valencies.

B. P. YADAVA and MOHAMMAD Yaseen, Lucknow.

At different temperatures the coagulation velocity constant β and the bimolecular constant K, have been determined. From the values of K at different temperatures

with a particular electrolyte the temperature coefficient and the energy of coagulation have been calculated. The specific conductivity and the viscosity of the sols have also been determined at different temperatures to give a comparative account of results. With these data the thermodynamic constant has been calculated.

The results obtained with one electrolyte have been compared with those of the other electrolytes to give a comparative account of coagulating powers of different electrolytes of different valencies.

75. Studies of the Kinetics of Oxidation of Sodium Thiosulphate by Potassium Persulphate.

C. D. BISHT and SATYA PRAKASH SRIVASTAVA, Naini Tal.

The kinetics of oxidation of sodium thiosulphate by potassium persulphate with particular reference to salt effect has been studied at 30°C and the following results have been obtained.

1. The total order of the reaction is unity, it being unimolecular with respect to persulphate ion and zero molecular with respect to thiosulphate ion.

2. The temperature coefficient for the reaction is 2.067 and the energy of activation is 13.729 Keals.

3. Silver ion has a negligible catalytic effect, while ferrous ion has an appreciable catalytic effect, while the catalytic effect of cupric and ferric ions is very great and is of the same order.

4. The salt effect in presence of potassium sulphate is found to be positive and of the primary exponential type at 0.06 M potassium persulphate and 0.01 M sodium thiosulphate concentration while at equimolecular concentration of the reactants (0.04 M) the salt effect is positive and of the primary linear type.

5. The salt effect in presence of potassium chloride at 0.06 M potassium persulphate and 0.01 M sodium thiosulphate concentration is positive and of the primary linear type.

Further work on the exact nature of the salt effect is being carried on.

76. Spectrophotometric Determination of Thorium with : 2-(4-Sulfo-2-hydroxynaphthylazo)-1,8-dihydroxynaphthalene-3,6-disulfonic acid and 2-(3,6-disulfo-8-hydroxynaphthylazo)-1,8-dihydroxynaphthalene-3,6-disulfonic acid.

SACHINDRA KUMAR DATTA, Coochbehar.

Two azo dyes have been prepared from 1-amino-2-naphthol-4-sulfonic acid and 1-amino-8-naphthol-3, 6-disulfonic acid and chromotropic acid. These dyes have been abbreviated as OH-SNADNS and DSNADNS respectively. They are reddish-violet in colour in alkaline medium and red in acid solution. Thorium produces bluish violet colour with OH-SNADNS and pinkish blue with DSNADNS in low acid concentration. In ultraviolet light these solutions appear deep violet and blue violet respectively. The thorium complexes form almost immediately on mixing the dyes with thorium nitrate solution and remain stable for a considerable period of time and also to a slight rise of temperature. The complex of the dye OH-SNADNS exhibit maximum absorbance at 610 m μ and of the dye DSNADNS at 620 m μ , while the dyes alone are found to show maximum absorbance at 520 and 530 m μ respectively. The colour intensity of the thorium complexes change with pH of the solution, maximum intensity being observed at pH 2.6 and 2 respectively for the complexes of OH-SNADNS and DSNADNS. The colour reactions obey Beer's law for a low concentration of thorium and their sensitivities, according to Sandell's criterion, are : 0.16 γ and 0.10 γ per sq. cm. respectively. A number of ions are found to

interfere in the determination of thorium with the dyes spectrophotometrically, when present in thorium solution; they are: copper, tin, iron calcium, barium, nickel, cobalt, cerium (IV), zirconium, gold, uranium and phosphates and fluorides

77. Physico-Chemical Study of Complex Formation—Part I Ti(III) with Oxalic Acid.

V. V. SUBBANNA and A. K. BHATTACHARYA, Sagar.

The complex formation between titanous chloride and oxalic acid was studied by conductometric and spectrophotometric methods using Job's method of continuous variation. The results showed the formation of a 1:1 complex between titanous chloride and oxalic acid which is brownish red in colour showed a maximum absorption at 410 m μ . The dissociation constant for the complex was determined from both conductivity and spectrophotometric data and the mean value obtained was 2.161×10^{-3} at 23°C.

78. Adsorption of Fluorescein on Hydrated Molybdic Oxide.

U. V. SHESHAIAH, Sagar

Hydrated molybdic oxide precipitated from a solution of ammonium molybdate with hydrochloric acid has been found to be a good adsorbent for the acidic dye fluorescein. The adsorption isotherms deviate from the ordinary ones and they are 'S' shaped being convex to the concentration axis. This is explained as due to the nature of the dye anions in solution where they exist in a highly associated state i.e. ionic micellar state. It has been found that the amount of the dye adsorbed increases both with time and temperature. The results point out that adsorption of fluorescein on hydrated molybdic oxide is mainly Chemisorption, possibly preceded by physical adsorption.

79. Studies on some less familiar metal ferro-cyanogen complexes.

WAHID U. MALIK, Aligarh.

Spectrophotometric and polarographic studies with Cr (III) give evidence of the formation of soluble complexes like $KCrFeCy_6$ and $CrFeCy_6$, and of sol-gel transformation taking place at higher temps. It was further observed that K_4FeCy_6 changes into $K_4FeCy_6 \cdot H_2O$ and subsequently into K_3FeCy_6 .

Preliminary studies on Cr (II) ferricyanides, Mn (III), Mo (III and VI) and Mn (III) ferro- and ferricyanides have been done by conductometry, potentiometry, amperometry, colorimetry and spectrophotometry. In the case of Cr (III) ferricyanide, the existence of an oxidation reduction phenomenon as well as the presence of compounds like $KCrFeCy_6$ and Cr_2FeCy_6 have been observed. Mn (III) forms a series of compounds both with K_4FeCy_6 and K_3FeCy_6 . Mo (VI) under ordinary conditions gives complexes of the type $(MoO_2)_2FeCy_6$ and $(MoO_2)K_2FeCy_6$ but soluble complexes under optimum pH conditions (3.1—4.0) are formed. Their composition together with other aspects regarding changes taking place in the ferrocyanide solution in presence of Mo (VI) are being studied by *absorptionometry*. Amperometric titrations have also given satisfactory results on these complexes. A stable sol. of Mo (VI) ferrocyanide (max. conc. 2 gms./litre) has been prepared. The ferricyanide of Mo (VI) exists as a soluble complex. The nature of the reaction of Mo (III) has been found to be quite different from Mo (VI). Beryllium does not appear to react with K_4FeCy_6 at ordinary temperatures but after about twenty-four hours sets

to a firm gel. In all cases it has been found that result vary with the method used. Non-uniformity is particularly observable with Cr (II) ferricyanide and Mn (III) ferrocyanogen compounds.

80. Studies on the sol-gel transformation of chromic ferro- and ferricyanides.

F. A. SIDDIQI and WAHID U. MALIK, Aligarh.

The metal ferrocyanogen complexes of chromium (iii) differ from other metal complexes in as far as that they form soluble complexes.

Spectrophotometric studies carried out in this laboratory have shown the existence of complexes like $KCrFeCy_6$ and $CrFeCy_6$. These complexes undergo gelation at higher temps., optimum temp. for Chromic ferrocyanide gel being 75°C and that for Chromic ferricyanide gel being 80°C.

The time of gelation was found to depend on the ratio of $Cr^{+++}/FeCy_6^{---}$.

Variations in conductance for gels prepared by mixing Chromic chloride in ratios 3 : 1, 1 : 1, and 1 : 4 were negligible. On the other hand, marked variations in pH were observed before and after gelation for gels obtained by using excess of potassium ferrocyanide (Molar ratio 0.24 : 0.4—4.0 to 7.4).

Permeability of different electrolytes through chromic ferrocyanide membrane was of the order

$KCl > KI > KBr > CrCl_3 > K_4FeCy_6 > K_3FeCy_6$

The membrane potential measurements using Michaelis method showed that the potential increases with time at first rapidly and then slowly. The relationship between permeability and membrane potential leads us to conclude that higher the membrane potential lower the permeability of ions.

81. Studies on the interaction of Cr (III) and tetra potassium-molybdenum octacyanide.

S. IFTIKHAR ALI and WAHID U. MALIK, Aligarh.

Chromium (III) complexes of tetrapotassium molybdenum octacyanide has not been cited in the literature. Unlike other metal molybdocyanides they exist as complexes in solution. On mixing the reactants a change in colour takes place which slowly develops into a red colour, the time for the development of colour depending on the concentrations used. Spectrophotometric studies (using Job's method of continued variation) have evidenced the formation of the complex $KCrMo(CN)_8$.

Two breaks were obtained in the conductometric curves giving the ratios $CrCl_3 : K_4Mo(CN)_8$ as 4.85 : 10 and 9.9 : 10. The existence of compound having formula $K_5Cr[Mo(CN)_8]_2$ could not, however, be confirmed by conductivity measurements carried out in the reverse order. The first break giving the ratio $Cr^{+++} : Mo(CN)_8^{4-}$ as 10 : 3.8.

Potentiometric titrations were also carried out using both chromium and platinum electrodes, which gave the evidence for the formation of complex $KCrMo(CN)_8$ only. Better results were obtained in aqueous-alcoholic media.

82. Polarographic study on the interaction of Chromium III with glycine.

A. AZIZ KHAN and WAHID U. MALIK, Aligarh.

Polarographic studies for the interaction of chromic chloride with glycine were carried out in the following media : (i) phosphate buffers pH 5.2 to 8.0 (ii) 0.1M KCl

pH 6.6 (iii) KCl-NaOH pH 8.2 to 9.7 (iv) KCl-HCl pH 2.3, with 0.001% gelatine as maximum suppressor (temp. $35 \pm 0.1^\circ$). The colour of the complex in media (i), (ii) and (iv) was reddish violet while in medium (iii) at pH 8.2 and 8.7 was violet and at pH 9.7 was green. The complexes under (i) and (ii) are reducible at the dropping mercury electrode, and well defined waves were obtained in both the cases. ($E_{1/2(i)} = 1.10$ and $E_{1/2(ii)} = 0.96$). However, well defined waves could not be obtained in media (iii) and (iv). Although the reduction was found to be irreversible in presence of phosphate buffers, reversible waves were found to exist in KCl media (pH 6.6). The diffusion currents were found to be proportional to the concentration of chromic ions and obey the Ilkovic equation in presence of excess of glycine.

Interesting phenomenon was observed in buffer medium. It was observed that the wave heights decrease continuously with time and vanishes completely after 24 hours and the reddish violet complex changes into a violet one.

83. Physico-Chemical Study of the Complex Formation of Beryllium ions with Organic Ligands.—Part I, With Oxalic Acid.

ARUN K. BHATTACHARYA and G. S. RAO, Saugar.

The complex formation between beryllium sulphate and oxalic acid has been studied by electrical conductivity method. Job's continuous variation method has been employed to find out the stoichiometric ratio of the complex formed. By using different concentrations of solutions the ratio works out to be 1:1. The value of the stability constant has also been determined from Job's enlarged equation. The value of the stability constant at 28°C . works out to be 8.333×10^{-4} and this has been found to be constant at different concentrations. However, the value of the stability constant is influenced by the variation of temperature i.e. at higher temperature there is an increase whereas at lower temperature there is a decrease in its values. The results in the influence of temperature on stability constant are in conformity with the observation of other workers.

84. High Frequency Titrimetry-study of Complexes.

S. K. K. JATKAR and C. J. DANGRE, Poona.

A crystal controlled 6MC oscillator using 6E5 tube which acts both as an oscillator and as a resonance indicator, was constructed and was used for the copper-ammonia and ferrocyanide complexes. Using both, the capacitor and inductive type of cells, the high frequency titration curves indicated the formation of a series of complexes at the metal-ligand ratios from 1 to 10 in both cases. The inductive type of cell gave more prominent peaks.

85. Dipolar Contribution of Associated Liquids to the Energy of Change of State.

S. K. K. JATKAR and C. M. DESHPANDE, Poona.

The new equation for associated liquids is

$$(\epsilon - n)^2 \cdot \frac{M}{d} = \frac{4\pi N \mu^2}{(T - \theta)}$$

where θ is a characteristic temperature, similar to Curie temperature, and can be identified with either the melting point or the transition point of the substance $R\theta$ is the minimum amount of energy required to start the parallel and anti-parallel orientation of the dipole, whereas $3RT_b$ will be the energy required to set the dipole in random orientation. The values of $R\theta$ and $3RT_b$ are correlated

with the latent heat of fusion and latent heat of vapourisation. $R\theta$ is compared with the ratio of $\frac{L_f}{C.N}$ where L_f is the molar latent heat of fusion and C.N. is the coordination number, $3RT_b$ is compared with the ratio

$$\frac{\Delta H_{\text{vap. int.}}}{4} \cdot \Delta H_{\text{vap. int.}} = \Delta H_{\text{vap.}} - RT.$$

The results show that $R\theta$ gives the dipolar contribution to the molar latent heat of fusion and $3RT_b$ gives the dipolar contribution to the molar internal latent heat of vapourisation. The relationship $3RT_b = \frac{\Delta H_{\text{vap. int.}}}{4}$ follows from Trouton's coefficients for associated liquids like water and alcohols.

86. Solvent Effect on Optical Rotation and Dipole Moment.

S. K. K. JATKAR and A. J. MUKHEDKAR, Poona.

For a comparative study of the solvent effect on optical rotation and dipole moment, equations have been deduced using identical assumptions ($F = F'$). It has been found that the solvent effect on optical rotation goes hand in hand with the parallel effect on dipole moment, especially when the important dipoles are directly attached to the asymmetric centre :

$$\beta_\lambda = a\mu + \{ \beta_\lambda^o - a\mu^o \} \quad (i)$$

where 'a' is relative deformability constant and β_λ and μ are rotational parameter and dipole moment respectively, the superscript 'o' indicating that property in the ideal state. The linear relationship (i) has been verified by the experimental data. The values of β_o for d-camphor in different solvents are comparable ($\sim 1.1 \times 10^{12}$).

87. Physical Properties of Organic Substances.

S. K. K. JATKAR and V. S. JATKAR, Poona.

Previous work of Schmidt, Lagemann, Lima, Aranda, Talati, Fraser, Marschner and Beverly, Tatevskii and Palit has been reviewed. A new relationship between molar refraction MR_o , and molar magnetic susceptibility X_m , has been shown. Knowing the value of molar refraction for a particular substance, the molar magnetic susceptibility can be calculated. Tables are given showing MR_o , $X_{m\text{exptl.}}$, $X_{m\text{calc.}}$ for homologous series of organic compounds.

88. On the Complete Dissociation of β -Resorcylic Acid.

B. N. MATTOO, Poona.

The three stages of dissociation of β -Resorcylic acid have been studied spectrophotometrically at 25°C. The results are reported as a function of ionic strength and discussed :

$$\begin{aligned} -\text{COOH} : \quad pK'_1 &= 3.30 - pK'_1 + \frac{0.5\sqrt{I}}{1+2\sqrt{I}} + 0.10 I; \\ &\quad (I=0) \quad (I) \\ p-\text{OH} : \quad pK'_2 &= 9.12, = pK'_2 + \frac{1.5\sqrt{I}}{1+2\sqrt{I}} + 0.06 I; \\ &\quad (I=0) \quad (I) \\ o-\text{OH} : \quad pK'_3 \quad (I=0) &= 15.6 \pm 0.1 \end{aligned}$$

89. Catalytic and Promoter Actions of Ammonium Molybdate and Sodium Nitrite in the Decomposition of Hydrogen Peroxide.

B. P. GYANI and D. R. NABH, Patna.

An M/20 Solutions of H_2O_2 (commercially stabilized) does not show any decomposition during a day at room temperature. It was observed that the reaction was *catalysed* by Ammonium molybdate (slow evolution of O_2) and *promoted* by $NaNO_2$. The optimum concs. of the catalyst and the promoter are M/1000 each at catalyst/promoter ratio=1. At all other ratios the rate is less irrespective of absolute concentrations.

The evolution of gas is dependent upon the rate and mode of stirring. One simple way to reconcile these observations would be to consider that the oxygen/solution interface of the bubbles formed is also a seat of catalysis.

90. Effect of Acids and Salts on the Decomposition of Hydrogen Peroxide in presence of Ammonium Molybdate and Sodium Nitrite.

B. P. GYANI and D. R. NABH, Patna

The decomposition of H_2O_2 catalysed by ammonium molybdate and promoted by $NaNO_2$ may be much affected by introducing varying quantities of different acids. As the HCl concentrations is changed from 7.5N to .001N in the mixture, a sharp minimum in the decomposition rate is observed at 0.1N (.05 M H_2O_2 , 30°C). With other common acids a maximum is observed (.001N for H_2SO_4 ; 0.1N for acetic acid; and .01N for phosphoric acid). In all these cases the maximum decomposition attained in certain acid concentrations is larger than the same in neutral solutions. This strong and anomalous effect of H^+ ions is not adequately accounted for in any mechanism of decomposition proposed.

Neutral salts generally depress the rate. The depressing action of anions appears to be $Cl > SO_4 > NO_3$ (Salt conc. from 1- .001 M). The cations generally give the order $K > Amm > Na$. Nitrates at all concentrations produce a poor depression. These observations tend to show that the mechanism must essentially involve acid-base catalysis.

91. Studies in regeneration of denatured proteins :—Part I, Gelatin.

N. D. PATEL and C. S. NARWANI, Bombay.

Gelatin (Mark's Gold label) on exposure to light for about four years became partially insoluble in water 80°—90°C. About 67% was soluble in water as determined by Kjeldahl's Method; the pH value of nearly 0.67% solution is 4.472, the viscosity coeff. 0.01016 (in C. G. S. units) and the specific rotation -116.8° . The insolubility was attributed to denaturing of the protein. The denatured protein became soluble when soaked in 5% glucose solution for 24 hours. The ppt. obtained on pouring this solution in acetone was allowed to settle, dissolved in distilled water and reprecipitated with acetone to free it from uncombined glucose. The precipitate was dried in a vacuum desiccator and then in air oven at 65°C. It was now found to be soluble in water at 70°C and specific rotation was -110° , the specific rotation of water soluble gelatin was -116.8° ; the diff. $+6.8^\circ$ might be attributed to the presence of glucose, perhaps in combined form. On keeping for a few days in a watch glass inside a cupboard it became dark brown and insoluble in water. It was soluble in dil. HCl giving a red solution. The colour and insolubility might be attributed to the action of light.

92. Effect of Alternating Current Frequencies on Redoxokinetic Effect.

H. P. AGARWAL, Bhopal.

In the theory worked out at low a.c. fields for "redoxokinetic effect" it was pointed out that at sufficiently high frequencies, the redoxokinetic effect should be independent of frequency. For correctly determining the value of 'a' of absolute reaction rates for platinum aqueous surface, it was necessary to find out the experimental conditions so as to locate the higher frequency region in which such determinations may be possible. A number of experiments carried out has shown that for ferrous-ferric system (Concentration of each ion is N/1000 in 1-N H_2SO_4) the redoxokinetic potential becomes independent of frequencies lying in between 100 to 10,000 cycles per second for low values of a.c., and below 100 cycles it varies in accordance with the theory worked out. It appears that this would enable the correct determination of the value of 'a' of Absolute reaction rates for platinum aqueous surfaces.

93. Effect of Surface Active Substances on the Redoxo Kinetic Potential of Ferrous-Ferric Redox System.

H. P. AGARWAL and LAL CHAND, Bhopal.

The addition of surface active substances shows a marked effect on the redoxokinetic potential. The values become less and less negative with the efficiency of the surface active substance added, for the same frequency and the a.c. voltage applied.

94. Spectrophotometric study of Aluminium-sulpho-salicylate Complex.

R. K. NANDA and S ADITYA.

Aluminium sulphosalicylate complex has been studied by a spectrophotometric method in the ultraviolet. The nature of the complex was found to be of the 1:1 type by the Job's method of continuous variation method. The extinction coefficient of the complex at 3100 \AA and of sulphosalicylic acid at the same wave length were found to be 4057 and 1781 respectively at pH 4.0. The dissociation constants of the complex were determined at the ionic strengths 0.02, 0.05, 0.1 and 0.2 and were 1.22×10^{-3} , 1.79×10^{-3} , 2.80×10^{-3} and 4.36×10^{-3} respectively, at pH 4.0. These values of the dissociation constant have also been verified by a displacement method using copper-sulphosalicylate complex as the indicator. The dissociation constant of copper sulphosalicylate complex at pH 4.0 and ionic strength 0.2 was found to be 0.93×10^{-3} . The dissociation constant of the aluminium sulphosalicylate complex, obtained by the displacement method, at pH 4.0 and ionic strength 0.2 has been found to be 4.69×10^{-3} .

95. Kinetics of the Formate-persulphate Reaction—Part II.

K. BAKSHI and D. PATNAIK, Cuttack.

The redox reaction between formate and persulphate ions has been found to be appreciably catalysed in the presence of Ag^+ ion. It has been observed that like the simple formate-persulphate reaction, the Ag^+ catalysed reaction is also not a homogeneous one, the rate being surface dependent and it also shows periodicity. The catalysed reaction has been studied at different ionic strengths for varying

concentrations of formate, persulphate and Ag^+ ions. The rate has been found to be dependent on persulphate and silver ion concentrations. A chain mechanism explaining the experimental results has been suggested.

96. Study of influence of number of exchangeable ions on the membrane potential: Part I, cellophane.

H. J. CHAINANI and C. S. NARWANI.

The cellophane has been oxidised with N_2O_4 to increase the number of $-\text{COOH}$ groups. The cellophane was immersed in a nearly 1% solution of N_2O_4 in CCl_4 for various intervals. The number of $-\text{COOH}$ groups in the cellophane as determined by Iodide-Iodate method increases with the time of immersion. It has been found out experimentally that the membrane potential (E) in case of the same ratio of concentration of HCl solutions on the two side, increases and approaches the Nernst Potential (E^0) and transport number of the H ion inside the membrane, calculated from equation $t_+ = \frac{E + E^0}{2E^0}$, increases with increase in the number of $-\text{COOH}$ groups. On maintaining the same concentration on one side of the membrane and varying the same on the other side, it has been observed that with decrease in concentration i.e. on increasing the ratio, the membrane potential increases and transport number of H ion inside the membrane decreases.

97. Viscosity of MgCl_2 and K_2SO_4 in Dioxane—Water Mixtures at 35°C .

P. B. DAS, P. K. DAS and D. PATNAIK, Cuttack.

The measurements of viscosity of MgCl_2 and K_2SO_4 in 10%, 20% and 30% by weights of dioxane-water mixture have been carried out to verify the modified Jones-Dole equation as suggested by us, (Curr. Sci. 1956, 25, 337). The experimental data for 20% and 30% solvents fit in well with the modified equation, whereas for solvents containing 10% of dioxane the Jones-Dole equation as such is valid. The constant 'B' has been found to depend upon the composition of the solvent.

98. Electron-microscopic Studies of Indian Rubber-grade China-clays.

A. S. GHAG, K. V. MODAK and M. B. KABADI, Bombay.

The authors have studied the rubber-grade china-clays from different parts of this country. The photographs of these taken by an electron-microscope RCA (EMU-2D). The authors conclude from these microphotographs that the clays from Kendposi (Bihar), Bhonda (Bihar) and Appenhalli (Mysore) are not pure kaolin clays. Their geological formation does not appear to have been complete. The other clays contain kaolinite particles but are not well defined. The clays from Palyangadi (Kerala), Kanuepuram (Kerala) and Thirthalli (Mysore) show good disaggregating tendencies. Palyangadi clay contains a few well defined Halloysite rubes and hence is observed to possess the best reinforcing characteristics.

99. Alloy Plating of Nickel and Tungsten.

A. JOGARAO and M. SUNDARAM, Karaikudi.

Where considerable hardness and wear resistance are desired at high temperatures as in some engineering applications, plating of tungsten alloys is advocated,

It has been stated that the V.P.N. Hardness numbers of these alloys vary from 400 to 600 and further improvement in this number is possible by heat treatment. Literature survey indicates that, ammoniacal baths with addition of tartaric or citric acids are used with a view to get deposits containing maximum possible Tungsten content.

The present study, relates to the use of fumaric acid, in Nickel sulphate Sodium tungstate-ammonia (adjusted to pH 8)-baths. Copper cathodes and nickel anode were employed. The bath composition was maintained by adding the required salts from time to time. Current densities ranging from 70 to 288 amps. per sq. ft. were applied at temperatures varying from 30° to 90°C. In almost all the experiments, alloy deposits were obtained but bright plates could be had only in c.d. range 70-140 amps per sq. ft.

100. Electrodeposition of zinc from zincate solutions.

R. VISWANATHAN, S. SAMPATH and H. V. K. Udupa, Karaikudi.

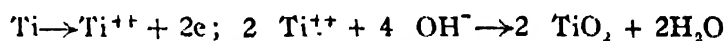
Electrodeposition of Zinc in the form of powder from sodium zincate bath using cathodes of graphite, titanium and tantalum has been studied. The results obtained at these cathodes are compared with those reported for magnesium cathode. Effect of the concentration of Zinc, current density on the nature of the deposit and current efficiency has been studied in detail for graphite cathode.

Cathode potential measurements at the different cathodes where powdery deposits are formed have indicated that these values follow the order of hydrogen evolution potentials on the same under high alkaline conditions and the ease of removal of the powder increases on cathodes having more negative potentials.

101. Electrochemical Behaviour of Titanium in Alkaline Solutions—Part I : Galvanostatic Measurements.

INDRA SANGHI and S. VISWANATHAN, Karaikudi.

Anodic polarisation of titanium under different current densities and in different concentrations of alkaline solutions has been studied under constant current conditions. Changes in electrode potential have been measured with a Luggin capillary and Hg/HgO/KOH as the reference electrode. Time-potential curves have been plotted and on anodic polarization the potential rises from an equilibrium value of about -0.6 V, to a final steady potential value of about +0.9 V, depending on concentration, current density and other conditions of polarisation. There appears to be more than one minor arrest in the polarisation curves although they are more evident in some cases and less in others. Typical curves can generally be divided into three branches i.e., initial linear and instantaneous rise in potential, final steady horizontal part and the parabolic potential rise at accelerated rate in between the first and final portions. The final steady part may be considered as the oxygen evolution potential (about +0.9 V) when the electrode is passivated and not much of titanium further goes into solution. These results and the probable mechanisms of electron transfer and chemical reaction in the various stages have been discussed in the light of numerous observations of various workers reported in literature. It is suggested that the passivation is due to the formation of a coherent TiO₂ layer as follows :



of the anatase type which is the main product of anodic polarisation in alkaline solutions.

102. Differential Thermal Analysis of Magnesium Chlorides.

W. K. BEHL and H. C. GAUR, Delhi.

Differential thermal analysis of the hydrated magnesium chloride ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$) (I) and hydrated magnesium ammonium chloride $\text{MgNH}_4\text{Cl}_2 \cdot 6\text{H}_2\text{O}$ (II) has been described. For (I) six peaks in all were observed corresponding to the conversion of Hexa- to tetra (70°C), tetra- to dihydrate (100°C), and the dehydration of di- (160°) and monohydrate (236°); in the last two simultaneous hydrolysis also occurred. Two false peaks were also observed which were ascribed to the fusion of dihydrate (116°) and the boiling of this solution (192°). For (II) the phase changes observed were; transformation of hexa- to tetrahydrate (100°), tetra- to dihydrate (145°), dihydrate to anhydrous MgNH_4Cl_2 and the decomposition of the double salt to give MgCl_2 and NH_4Cl (236°).

103. The variation of NH_4^- , Mg- and Ba-ionic activities in colloidal clays with concentration of the disperse phase.

A. CHATTERJEE, Calcutta.

The variation of the activity of NH_4^+ , Mg^{2+} , and Ba^{2+} ions of clays, saturated with these ions, have been determined at various concentrations of the clays by means of clay membrane electrodes. The ionic activities of NH_4^+ increase almost linearly upto a certain concentration of the clay (nearly 10%) but afterwards the rate of increase slows down. This tendency is more prominently exhibited by the Mg- and Ba-clays at considerably lower concentrations.

The percentage dissociation of NH_4 , Mg- and Ba-clays shows a sharp rise to a maximum (1.1%, 1.4% and 0.7% respectively) followed by a steady decrease.

NH_4 -clay, however, behaves differently, like Na- and K-clays, which shows a second increase and a more or less flattened maximum at about 9.3%.

104. Studies on the Reaction Kinetics of Annealing of Metamict Minerals (Fergusonite, Brannerite and Samarskite) by Means of Differential Thermal Analysis.

JAGDISH SHANKAR, S. B. SRIVASTAVA and M. H. RAO, Bombay.

The present studies have indicated that the overall order of 'reaction' governing the course of annealing is of the order of 1.6 and the associated activation energy varies from 82 Kcal to 110 Kcal. The 'stored energy' has also been found to vary from 8 cal/gm to 16 cal/gm. The mechanism of annealing appears to be very complex.

105. Spectrophotometric Studies on the Uranyl Complex with Thenoyl Trifluoroacetone.

K. M. ABUBACKER and N. S. KRISHNA PRASAD, Bombay.

The nature and composition of uranyl-thenoyl trifluoroacetone (TTA) complex in aqueous-alcoholic media was investigated by spectrophotometric studies. Uranium was found to form a 2:3 complex with TTA. The alcoholic content of the solution was found to have an appreciable effect on the intensity of the complex. However, the ratio of UO_2^{++} :TTA in the complex was independent of the alcoholic content of the solution. The pH of the solution also had appreciable

effect on the colour intensity of the complex. The optimum pH range was 5-6.5, with the colour intensity being a maximum at pH 6. Beer's law was applicable to solutions of the complex in the concentration ranges 1-2-12 ppm of U in 50-75% alcohol and 5-50 ppm in 25% alcohol.

106. Kinetics of Decomposition of Yttrium, Cerous and Zirconyl Oxalates.

M. C. NAIK and R. P. AGARWALA, Bombay.

The energy of activation and order of reaction for the decomposition of yttrium, cerium^{III} and zirconyl oxalates have been determined by thermal gravimetric and differential thermal analysis methods.

107. Effects of Dilution on Szilard-Chalmers Reaction with Tris Acetylacetonate Co(III).

J. SHANKAR, K. S. VENKATESWARLU and MANOHARLAL, Bombay.

Mixed crystals of tris acetylacetonate cobalt(III) and tris acetylacetonate aluminium(III) were irradiated with thermal neutrons. The retention of cobalt was found to be dependent on the dilution with the aluminium complex. The retention decreased with increasing dilution. Isothermal annealing studies also revealed the same trend in retention values. An ion exchange method using 50% methanol and 50% water was developed for the separation of the retentive activity.

108. Investigation on some physical properties of clays and their dependence on the nature of the exchangeable cations.

S. K. NANDI, Calcutta.

The physical properties such as swelling and extrusion plasticity of clay salts prepared from clay minerals were studied. Swelling was measured by means of a modified form of Freundlich's apparatus. The swelling capacity of Na-bentonite in water as corrected for the pore space was found to be about four times of that of Ca-bentonite. The plasticity was measured by an extrusion Plastometer as designed by Freundlich and Jones. The length of the thread obtained which is a measure of plasticity was the same with the pastes of Na-bentonite and Ca-bentonite under the same pressure, only when Na-bentonite contains water about four times of that required by Ca-bentonite.

109. Differential thermal analysis of Indian Rubber Grade China Clays.

A. S. GHAG, K. V. MODAK and M. B. KABADI, Bombay.

The authors have studied the differential thermal analysis of the different rubber-grade china-clays obtained from different parts of this country. The clays from Bhonda (Bihar) and Kendposi (Bihar) give absolutely irregular curves. The clay from Rairangpur (Orissa) and Appenahalli (Mysore) show the endothermic reaction at about 600°C characteristic of a kaolin clay but were found to contain large amounts of impurities. Appenahalli clay does not show the expected exothermic reaction at 1000°C. Other clays show both the endothermic reaction at 600°C and exothermic reaction at 1000°C expected of a typical kaolin clay. The results of this work were in agreement with those from the electron-Microscopic work.

110. Some Experiments on the Growth and Purity of Ionic Crystals.

SUNIL K. DATTA, Calcutta.

The role of impurity ions in causing the formation of colour centres in ionic crystals under ionizing radiation is not fully known. While it is true that some impurity ions act as catalysts in enhancing the darkenability of a crystal it is not established if a sufficiently pure crystal would remain uncoloured under such radiation. In order to gain some insight into this problem experimental techniques were sought to be developed which would yield single crystals of typical ionic solids like alkali halides in a highly pure state and in sizes suitable for subsequent physical measurements.

The single crystals prepared by special care and the discs were irradiated with x-rays under specified conditions and the optical absorption studied with a spectrophotometer. From the peaks and their widths at half-height in the absorption curves the colour centre concentration was calculated using the Smakula equation. The concentration of F-centres (in units of 10^{16} per cc.) for the different samples of KCl were : water grown, 2.9; vapour grown, 1.8; pressed disc, 4.1. It appeared from my observations that impurities cause an increase in the darkenability of the sample, but the observed changes, though in the expected direction, are rather small.

111. An Improved Microelectrophoresis Cell.

M. C. RASTOGI, Lucknow.

A mathematical expression for the improved microelectrophoresis cell was derived by usual method of geometrical optics when the cell wall separates air and experimental liquid. It was shown that if the cell was surrounded by experimental liquid (water in our case), the error introduced in the mobility measurements due to the refraction was 0.02% of the internal radius of the tube. The mobility of silver iodide sol particle ($P_z=4$) determined at the stationary level was found to be $3.5\mu/\text{sec./volt/cm.}$, which is in good agreement with those obtained by van Gils and Kruyt.

112. A complexometric method for the study of Kinetics of Oxidation of Organic Compound by Potassium Dichromate.

(MISS) K. K. ROHATGI and PRANAB K. BHATTACHARYA, Calcutta.

A method has been developed for the estimation of Cr^3 in presence of Cr^6 . Trivalent chromium forms a purple complex with disodium salt of ethylene diamine tetra-acetic acid. The complex has two absorption maxima, one at $4396 \text{ m}\mu$ and the other in the visible region, at $4546 \text{ m}\mu$, $E_{\text{per Cr atom}}^{1\%1\text{cm}}$. Since $E_{\text{per Cr atom}}^{1\%1\text{cm}}$ for the uncomplexed green chromic ion, Cr^{+++} is 17.3, complexation increases the sensitivity of the colorimetric estimation of Cr^3 by about twelve times. The coloration is obtained by simple warming and is stable in not too acid a solution ($\text{pH}>1$).

The suitability of the method has been tested by applying it to the study of the kinetics of thermal and photo-chemical oxidation of ethyl alcohol and glycerol by potassium dichromate under various experimental conditions. Good straight lines are obtained for the initial rates.

113. High Frequency Titration of Mercaptans.

(Miss) BANYA ROY, KANAI LAL MALLICK
and
SACHINDRA NATH MUKHERJEE, Calcutta.

High frequency titration method has been extended to the estimation of mercaptans in very dilute solution by titration with iodine solution. Benzyl mercaptan and thioglycolic acid have been successfully titrated with the H.F. titration apparatus utilising the frequency of 6.47 megacycles per sec. The circuit of this apparatus is a modification of that proposed by Hall or Jensen and Parrack (Ind. Eng. Chem. Anal. Ed., 18, 595, 1946), the beaker containing the solution was placed in parallel with the capacitor circuit and not in the tank coil. This method is particularly advantageous for the estimations of mercaptans in very dilute solutions as well as in the coloured solutions where the visual titration of mercaptans by iodine solutions fails. The titrations were mostly carried out in alcoholic solutions.

114. Alkaline hydrolysis of Acrylic and Methacrylic Esters.

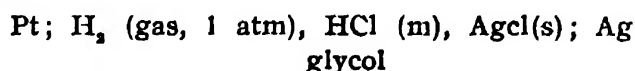
PRANAB BHATTACHARYA, SUKHOMOY CHAKRAVARTY
and
KANAI LAL MALLICK, Calcutta.

The alkaline hydrolysis of acrylic and methacrylic esters in 60% aqueous ethanol has been studied at 7°, 20°, 30° and 40°C. The rate constant for the acrylate is higher than that for the corresponding methacrylate. In the same series, the methyl ester gives a higher rate than the ethyl ester. The energy of activation and the PZ factor have been determined for the hydrolysis of these esters. For methyl acrylate and methyl methacrylate the energy of activation is nearly the same (about 14.3 Kcals/mole), the PZ factor being slightly lower for the methacrylate. Comparing the two ethyl esters, on the other hand, the activation energy for ethyl methacrylate (about 15.1 Kcals) has been found to be about 1800 calories higher than for ethyl acrylate (13.3 Kcals/mole).

115. Activity Coefficients of HCl in Glycols and the Medium Effect.

KIRON KUMAR KUNDU, Calcutta.

The mean molal activity coefficient of HCl, γ_{\pm}^* at 30°C in ethylene and propylene glycols have been computed for .005 to .10 molal concentration of HCl (m) from the e.m.f. studies of the cell :



This activity coefficient being referred to a value of unity at infinite dilution of HCl in each particular solvent expresses the departure from ideal behaviour resulting from interionic electrostatic forces but obscures the change that activity coefficient on the water scale undergoes. If the activity coefficient in different solvents is referred to the dilute aqueous solution, it would approach a value different from unity in solvents other than water.

The activity coefficient values of HCl at different concentrations of the solute in ethylene and propylene glycol as well as ethyl and methyl alcohols referred to water basis, λ_{\pm} have been evaluated from the equation :

$$\log \gamma_{\pm} = \log \gamma_{m\pm} + \log \gamma_{\pm}^* \quad \dots \dots \dots (1)$$

where $\gamma_{m\pm}$ the activity coefficient of the acid at zero concentration of the electrolyte in non-aqueous solution referred to unity at the standard state (aqueous solution in infinite dilution)—is the primary medium effect i.e., the limiting value of activity coefficient in different solvents.

The values of $\gamma_{m\pm}$ have been computed for these solvents from the equation :

$$\log \gamma_{m\pm} = \frac{F(E^\circ - E^{\circ*})}{4.605 RT} \quad \text{where } E^\circ \text{ is the standard potential of Ag-AgCl electrodes in water, } E^{\circ*} \text{ is that for the non-aqueous solvent, all these values being known.}$$

The values of $\gamma_{m\pm}$ at 30°C in ethylene glycol, propylene glycol, ethyl alcohol and methyl alcohol are found to be 47, 123, 369, 92 respectively (referred to unity in water).

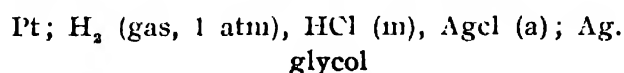
Using these values of $\gamma_{m\pm}$ for these solvents, γ_{\pm} values have been computed from the values of γ_{\pm}^* at the corresponding molalities of HCl in each of the solvents. These values of γ_{\pm} are comparable in different solvents at any particular concentration.

116. Standard Potential of Silver-silver Electrode in Glycols at 30°C.

KIRON KUMAR KUNDU, Calcutta.

While studying the quantitative aspects of acidity and basicity of some common organic acids and bases in ethylene and propylene glycols by way of dissociation constants, one important prerequisite is to find out the standard potential of some suitable reference electrodes with respect to normal hydrogen electrode in these solvents. Ag-AgCl electrode has been found to behave quite reliably and with good reproducibility in both the solvents and can be used as a suitable reference electrode in those media.

The standard molal potentials E_m° of Ag-AgCl in both the solvents have been determined by the classical method using the following cell without liquid junction :



The values of E_m° have been found out by using the function E° defined by the equation :

$$E^\circ = E + 2k \log m - \frac{2K S_f \sqrt{c}}{1 + A\sqrt{c}} - 2k \log (1 + 0.02 Mm) \\ = E_m^\circ + f(m).$$

and extrapolating the E° values to zero molality of HCl,

where E is the observed e.m.f. of the cell at molal concentration m ,

$$k = 2.3026 RT/F.$$

S_f and A are Debye Huckel constants for two solvents, A also involves a° —the apparent ionic diameter, c being the corresponding molar concentration of HCl solution and M the molecular weight of the solvent.

The standard molal, molar, and mol fraction unit potential E_m° , E_c° , E_N° of Ag-AgCl electrode for ethylene and propylene glycols are .024, 0.029, -0.120; 0.025, -0.023, -0.160 volts respectively.

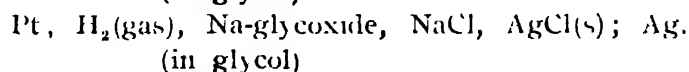
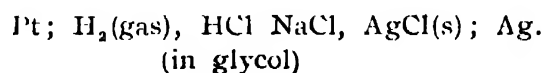
117. Autoprotolysis constant of Propylene Glycol.

SUKHOMOY CHAKRAVARTY and KIRON KUMAR KUNDU, Calcutta.

The autoprotolysis constant (K_s) of an amphiprotic solvent is an important physical quantity in the studies of ionisation of acids and bases in that solvent

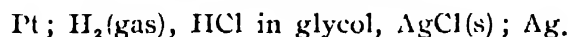
It is also a measure of the range of proton activity in that medium. In order to find out this range for propylene glycol, an amphiprotic solvent, measurements have been carried out to determine this constant.

The autoprotolysis constant of propylene glycol has been determined at 30°C by following the method of Hammett and Dietz employed for formic acid medium. The method essentially consists of measuring the potentials of the cells of the following type :



and combining these results suitably so that 1% Ag/AgCl could be avoided.

In actual practice the method involves the titration of hydrochloric acid solution in propylene glycol against sodium glycoide in the same solvent and measurements of potentials on both sides of the inflexion point to a considerable extent with the help of a cell of the following type :



the value of the autoprotolysis constant (K_s) has been calculated from the equation :

$$-\log K_s = \frac{E_{ab}}{2.3026 RT/F} - \log c_a \times c_b$$

where c_a is the molar concentration of the unneutralised acid and c_b the molar concentration of the base present in excess at this point on either side of the inflexion point on the titration curve and E_{ab} is the difference in measured e.m.f. corresponding to those two points.

The value of K_s at 30°C is 6.9×10^{-17} .

118. Spectrophotometric investigation of Uranyl Azide Complexes in Aqueous Solution.

NAIR B. K. S., PRABHU L. H., and VARTAK D. G., Bombay.

Spectrophotometric observations on mixtures of uranyl and azide ions give strong indication of the formation of a complex or complexes between the uranyl and azide ions. The application of the Job's method of continuous variation and the method of Bent and French to the system indicates that only a single uranyl-azide complex is formed within the range of concentrations studied. All the measurements were made in the pH range 2.8 to 3.2 in solutions at ionic strength of 0.12 or 0.28 adjusted by addition of sodium perchlorate. The experimental data are interpreted unambiguously in terms of a complex formula $(\text{UO}_2\text{N}_3)^+$. The stability constant of the complex as determined by the method of McConnell and Davidson is 4.45×10^3 in solutions at ionic strength 0.28.

119. A Spectrometric investigation of Titanium Complexes with Protocatechuic Acid? Gallic Acid and Catechol.

SATHE, R. M. and VENKATESWARLU CH., Bombay.

The system of titanium-protocatechuic acid is investigated using different spectrophotometric methods. Stepwise formation of three complexes TiR , TiR_2 and TiR_3 , is observed. The stability constants are given. These findings are compared with those of gallic acid and catechol in showing the usefulness of Job's method of continuous variation in non-equimolar solutions in those cases where

there is considerable hydrolysis of the metal ion under conditions of complex formation.

120. An Electron Diffraction Study of the Effect of Codeposition of Foreign Material on the structure of Iron Electrodeposits.

A. K. N. REDDY, Karaikudi.

An electron diffraction study has been made of iron electrodeposits on copper (110) and (111) single-crystal faces. A comparison has been made of the orientation of these deposits (a) when they reveal the incorporation of crystalline codeposits, and (b) when inclusions of foreign matter are absent. Ring radii measurements strongly suggest that the codeposit is hexagonal ferrous hydroxide. Further, it has been shown that, in the presence of codeposit, the iron electrodeposits (obtained at a particular current density) have crystal orientations which were normally obtained at higher current densities.

121. Corrosion of Cathode in Commercial Electrolysis of water.

K. S. G. DOSS, S. VISVANATHAN and INDRA SANGHI, Karaikudi.

The end cathodes of mild steel used in commercial oxygen hydrogen cells have been found to suffer from localised corrosion on their back sides (farthest from the anode surface). This is rather curious in view of the generally accepted idea of cathodes being free from corrosion, and particularly the commercial practice of using cathodic currents for preventing mild steel corrosion. As the problem is both of theoretical and practical interest, a preliminary attempt has been made to understand the phenomenon and to find out ways of eliminating such corrosion. Current density distribution, as existing under actual polarisation conditions similar to those obtained in commercial cells, has been studied both on the front and back side of the cathode by specially designed probe electrodes of platinum as well as of Luggin capillaries attached Hg/HgO/KOH reference system. Such studies reveal that in certain regions the current suddenly reverses on the back side indicating that those localised regions on the back side of the cathode may be behaving as slightly anodic with respect to their environment. This phenomenon has been discussed in the paper and an explanation offered on the basis of end cathodes behaving as bipolar electrodes to some extent. This has been further verified by using glass plate 'blinkers' or 'shields', placed in the gaps between the cathode edges and the sides of the cell, which effectively eliminate the reversal of the direction of the current to a large extent. This brief study thus indicates the causes of corrosion of end cathodes as well as a way for its elimination in commercial electrolysis of water.

122

122. "The Structure and growth of Nickel Electrodeposits on Electropolished Copper Single-Crystal Substrates".

A. K. N. REDDY, Karaikudi.

This paper describes an exploratory electron diffraction investigation of nickel electrodeposited on the copper (110) and (111) faces at various current densities and up to different thicknesses. The pattern of growth is largely similar to that observed with silver (also f.c.c. like Ni) deposited on to copper. The similarity includes the initial parallel orientation and the subsequent development of a random orientation after passing through a transition twinning stage. In contrast

to the Ag- Cu deposit-substrate pair, no "directed disorientation" of the Ni deposit lattice was observed probably because the lattice misfit was only 0.09 \AA° for Ni-Cu. The diffraction patterns also showed the gradual roughening (through facet formation) of the deposit surface even when initial deposition was on an atomically smooth electropolished substrate.

123. Studies regarding the formation of Hydrazine in glow discharge electrolysis

B. S. R. SASTRI, Karaikudi.

Various attempts were made to obtain Hydrazine by the electrochemical oxidation of Ammonia under different conditions with relatively little success. The author felt that glow discharge electrolysis, a recent technique for the application of electrical energy to chemical reactions might be of some advantage.

Experiments with solutions of Ammonia (Sp. gr. 0.9) Ammonium chloride, Ammonium sulphate, Urea, Urea with alkali and Sodium chloride were tried. The presence of Hydrogen peroxide was definitely established but no positive evidence for Hydrazine was indicated. Glow discharge electrolysis is primarily a vapour phase reaction and the hydrogen peroxide produced destroys any Hydrazine that might have been formed. However the use of liquid ammonia might be more favourable for the formation of Hydrazine under glow discharge electrolysis.

124. The Thermal Decomposition of Mercuric hyponitrite.

TRAMBAKLAL M. OZA and GUNVANT T. OZA.

A study of the decomposition of pure mercuric hyponitrite, in vacuo, under varying conditions of temperature, time and mass and in an atmosphere of oxygen shows that both nitric oxide and nitrous oxide are formed as found by Divers and that these are accompanied by mercury, mercurous and mercuric oxides and mercurous nitrite. The initial change may be $2\text{HgN}_2\text{O}_2 = \text{Hg}_2\text{N}_2\text{O}_2 + 2\text{NO}$, and may be followed by the decomposition of mercurous hyponitrite so formed, into mercurous oxide and nitrous oxide. Formation of mercurous nitrite might occur through the intermediate production of oxyhyponitrite by interaction between the hyponitrite and mercuric oxide. Conditions conducive to the production of nitrogen dioxide in the system seem to influence the production of mercurous nitrite. The proportion of mercuric oxide in the decomposition products is high at the start of the decomposition and falls later with progress of the decomposition.

125. The Thermal Decomposition of Mercurous Hyponitrite.

TRAMBAKLAL M. OZA and RAJNIKANT H. THAKAR, Bombay & Ahmedabad.

A study of the decomposition of pure mercurous hyponitrite in vacuo, under varying conditions of temperature, time and mass has led to (a) isolation of mercurous oxide, (b) production of nitrous oxide alone as gaseous product in the initial stage and (c) identification of mercurous nitrite in the products. The formation of mercurous nitrite is accelerated when the hyponitrite decomposed in the presence of mercuric oxide. It appears that mercurous hyponitrite decomposes in the initial stage as $\text{Hg}_2\text{N}_2\text{O}_2 = \text{Hg}_2\text{O} + \text{N}_2\text{O}$, a part of the mercurous oxide formed decomposing simultaneously into mercuric oxide and mercury. The formation of mercurous nitrite can be explained if it is assumed that mercuric oxide and mercurous hyponitrite interact to produce, as an unstable intermediate, mercuric oxy-hyponitrite which then decomposes into mercurous nitrite and nitric oxide. Nitric oxide is observed in the products.

126. Optical Properties of Thorium Phosphate Gel Forming Systems.

U. M. PURAO, D. M. DESAI and M. B. KABADI, Bombay.

The changes in the depolarisation and the intensity of transversely scattered light of thorium phosphate gel systems, obtained by the dilution of the acid solution of thorium phosphate, have been investigated. The results show that the particles gradually increase in size during gelation while anisotropy decreases considerably. This study also reveals that the gel particles are isotropic and spherical in nature. The intensity values show only a very slight increase while the dissymmetry : ratio $145^\circ/1135^\circ$ fails to throw any light on the probable shape of the particles.

127. Optical Properties of Aluminium Succinate Gel Forming Systems.

U. M. PURAO, D. M. DESAI and M. B. KABADI, Bombay.

The changes in the depolarisation and the intensity of transversely scattered light of aluminium succinate gel forming systems obtained by the method of Mushran and Bose have been investigated. The results show that the particles gradually increase in size during gelation. The intensity values show that in the initial stage there is formation of the colloid substance, then hydration of the gel forming substance, and subsequent formation of specific three dimensional net work. It has been found that the colloid particles are slightly anisotropic in nature and their anisotropy is not perceptibly disturbed. This is shown by the ρ_v values. The dissymmetry : ratio $I_{15^\circ}/I_{135^\circ}$ fails to throw any light on the probable shape of the gel particles.

128. On the solution of formation functions of metal-ligand systems.

K. S. MATH, K. A. VENKATACHALAM and M. B. KABADI, Bombay.

It is shown that when pH measurements are converted into formation constant data, the half integral values yield sufficiently accurate log. K values for much lower values of K_1/K_2 than pointed out by Irving and Rossotti. Also the minimum values of log. K_1/K_2 for which the two steps of the formation curve for an over all 1:2 complex, can be treated separately, using only limited portions of the formation curve, have been calculated for desired accuracy of log. K value.

ORGANIC CHEMISTRY**129. Effect of Allyl Group on Optical Rotatory Power in Derivatives of Reichler's Acid.**

O. N. PERTI and B. C. PANT, Naini Tal.

The allylamine salts of D-and L-camphor- β -sulphonic acid have been prepared and characterised. Its optical rotatory power has been studied in water, methyl alcohol, ethyl alcohol, chloroform and pyridine. In each solvent it was found to exhibit simple dispersion in the visible region. When its rotatory power is compared with that of ammonium-D- or L-camphor- β -sulphonate it is found that the effect of allyl group is to cause a decrease in rotatory power.

130. Synthetic use of (+) Amyl Bromide from Fusel Oil.

K. A. THAKER and I. G. VASI, Vallabhvidyanagar.

Fusel oil give (-) amyl alcohol ($\alpha_D = -1.109$, $l=2$) which forms (+)- amyl bromide readily ($\alpha_D = +0.2629$, $l=2$). The use of active amyl bromide for its synthetic use has been taken in this investigation. This is mainly divided into two parts.

- (1) Use of (+) amyl bromide to get ethyl (+) amyl acetoacetate and its further use synthetically.
- (2) Use of (+) amyl bromide to prepare the Grignard complex (+) amyl, Mg.Br and to react with various ketones to get the active alcohols with the introduction of different radicals in the ketone series. The optical dispersion of these alcohols of the general types, $R.CH_2.(+)C_4H_9.C-OH$, in which R is methyl, ethyl, n-propyl, n-butyl, n-amyl and n-hexyl has been studied.

131. Studies in Halochalcones and Related compounds : Synthesis of 3':5'-dibromo-2'-hydroxychalcones and their derivatives.

G. C. AMIN and C. M. CHRISTIAN, Ahmedabad.

3:5-Dibromo-2-hydroxy acetophenone has been condensed with (a) benzaldehyde (b) 2-hydroxy- (c) 3-hydroxy- (d) 4-methoxy (e) 3:4-dimethoxy- and (f) 3:4-methylenedioxy benzaldehydes in presence of 40% alcoholic KOH and the chalcones were obtained. These were converted into the corresponding 6:8-dibromo-flavanone, flavone and -flavonol derivatives by the action of dilute ethanolic acid, by selenium dioxide and by alkaline hydrogen peroxide respectively.

132. The Fries Rearrangement of the Esters of 4-Nitro Resorcinol.

G. C. AMIN, A. S. U. CHAUGHULEY and G. V. JADHAV, Visnagar, N.G. and Bombay.

The Fries Rearrangement of 4-nitro resorcinol diacetate, dipropionate, dibutyrate, dibenzoate and 1- and 3-monobenzoates gave 2-acyl-4-nitro resorcinols as main products. However, the diacetate and the dipropionate gave 2:6-diacetyl- and 2:6-dipropionyl-4-nitro resorcinols in addition to monoketones. It is significant that no monoketone of the type 6-acyl-4-nitro resorcinols could be isolated in any case. This behaviour is parallel to the Friedel-Crafts acylations of 4-nitro resorcinol as observed by Naik, Thaker and Shah (Proc. Ind. Acad. Sci., 1953, 374, 765).

133. The Fries Rearrangement of the Esters of 2-Nitro Resorcinol.

G. C. AMIN, A. S. U. CHAUGHULEY and G. V. JADHAV, Visnagar, N.G. and Bombay.

The Fries rearrangement of 2-nitro resorcinol diacetate, dipropionate, dibutyrate and dibenzoate gave 4:6-diacyl-2-nitro resorcinols. But in the case of the dibenzoate, 4-benzoyl-2-nitro resorcinol was also obtained in addition to the diketone. The Friedel-Crafts acylations of 2-nitro resorcinol by means of 2 mols. of acylating agents also gave the same diketones, while 4-acyl-2-nitro- resorcinols were formed on using 1 mol. of the acid anhydrides. Thus, the presence of nitro group in the 2-position of the resorcinol nucleus did not retard the Fries and Friedel-Crafts reactions,

134. The Fries Rearrangement of Cinnamates of Monohydric Phenols.

G. C. AMIN and C. M. CHRISTIAN, Visnagar, N.G. and Ahmedabad.

The Fries rearrangement of phenyl cinnamate, 2-methyl-, and 3-methyl-phenyl-cinnamates afforded 4-cinnamoyl phenolic compounds or chalkones while 4-chloro-5-methyl- and 4-benzoyl-phenyl-cinnamates gave the corresponding 2-cinnamoyl compounds. These were characterised by direct comparison with authentic samples. On the other hand, 4-methyl-, 2-chloro-, 2:4-dichloro-, 2:4-dibromo-phenyl and 1-naphthyl cinnamates gave only uncrystallisable pasty masses.

135. Synthesis of 5'-benzoyl-2'-hydroxy-chalkones and related compounds.

G. C. AMIN and USHA G. JOSHI, Visnagar, N.G. and Ahmedabad.

5'-benzoyl-2'-hydroxy chalkones have been synthesised by condensing 5-benzoyl-2-hydroxyacetophenone with ten hydroxy and methoxy aromatic aldehydes in presence of dilute ethanolic potassium hydroxide. These chalkones were converted into the corresponding 6-benzoyl-flavonoid derivatives by means of various reagents

136. Partial hydrolysis of substituted amides of cyanacetic acid by (a) polyphosphoric acid and (b) sulphuric acid.

C. M. MEHTA and G. H. PATEL, Baroda.

Substituted amides of cyanacetic acid, $-\text{NC} \cdot \text{CH}_2 \cdot \text{CONHR}$, have been partially hydrolysed by means of separately using (a) polyphosphoric acid at 110°C as well as (b) 75% sulphuric acid in cold; and in each case the corresponding malon-monoamides, $-\text{H}_2\text{NCOCH}_2\text{CONHR}$, were obtained. The yields by both methods were almost quantitative, but the products in (b) were more clear and the method is relatively simple.

137. Synthesis of 2:4-dihydroxy quinoline derivatives on cyclization of (a) malon mono-arylacids and (b) malon mono-arylamides by means of polyphosphoric acid (PPA).

C. M. MEHTA and G. H. PATEL, Baroda.

Malon mono-arylacids, $-\text{HOOC} \cdot \text{CH}_2 \cdot \text{CONHR}$, (I), have been cyclized to give 2:4-dihydroxy quinoline derivatives using polyphosphoric acid at 140°C for three hours. Similarly, malon mono-arylamides, $-\text{H}_2\text{NCO} \cdot \text{CH}_2 \cdot \text{CONHR}$, (II), gave the corresponding 2:4-dihydroxyquinoline derivatives with the elimination of ammonia by means of PPA. Required quantity of 1 N hydrochloric acid was then added in cold and the reaction mixture in each case was neutralized with sodium hydroxide solution to precipitate the product, which was crystallised from dilute acetic acid as a white compound. The yield with type I compounds is quantitative; while that with those of type II is poor.

138. Selenium dehydrogenation of Chandrine.

MRS. BITHIKA BOSE, Calcutta.

Chandrine $\text{C}_{22}\text{H}_{30}\text{O}_8\text{N}_2$, the base isolated from *Rauwolfia serpentina* Benth (1), on selenium dehydrogenation gave the same products from which norharman (3),

has been isolated in pure crystalline form, mp. 197° and its picrate 260°. Pyridine like bases were also produced in considerable amount particularly if the reaction temperature was kept above 300° for prolonged period. However, no trace of yobyrine or alstyrene could be obtained. Norharman was one of the products of alkali fusion of chandrine.

139. Synthesis of New Local Anaesthetics—Part III.

P. N. BHARGAVA and K. A. JOSE, Varanasi.

Piperidinoacetyl-2-aminobenzthiazole, piperidinoacetyl-2-amino-4-methylbenzthiazole, piperidinoacetyl-2-amino-5-methylbenzthiazole, piperidinoacetyl-2-amino-6-methylbenzthiazole, piperidinoacetyl-2-amino-4-chlorobenzthiazole, piperidinoacetyl-2-amino-6-chlorobenzthiazole, piperidinoacetyl-2-amino-4-ethoxybenzthiazole and their hydrochlorides have been synthesised and their local anaesthetic activity tested.

The study of the pharmacological screening has shown that the hydrochloride of piperidinoacetyl-2-amino-6-methylbenzthiazole is the most potent of all the compounds described here and also among the three methyl derivatives. Piperidinoacetyl-2-amino-4-ethoxybenzthiazole is the second in order of pharmacological activity. It is all the more interesting to find that the hydrochlorides of piperidinoacetyl-2-aminobenzthiazoles described require less time for the onset of anaesthesia than the standard substance procaine hydrochloride used.

140. Synthesis of New Local Anaesthetics—Part II.

P. N. BHARGAVA and PARASHU RAM SINGH, Varanasi.

Piperidinoacetyl-2-amino-4-phenyl thiazole, piperidinoacetyl-2-amino-4-p-chlorophenyl thiazole, piperidinoacetyl-2-amino-4-p-aminophenyl thiazole, piperidinoacetyl-2-amino-4-methyl thiazole, piperidinoacetyl-2-amino-4-chloromethyl thiazole, piperidinoacetyl-2-amino-4-5-dimethyl thiazole and piperidinoacetyl-2-amino-4-methyl-5-ethyl thiazole have been synthesised and their local anaesthetic activity tested. The hydrochlorides of piperidinoacetyl-4-methyl-5-ethyl thiazole, piperidinoacetyl-2-amino-4-p-chlorophenyl thiazole and piperidinoacetyl-2-amino-4-p-aminophenyl thiazole are seen to be most active local anaesthetics. The values obtained for these compounds are less than the value for the standard substance procaine hydrochlorides. The low activity for the hydrochlorides of piperidinoacetyl-2-amino-4-substituted thiazoles of aliphatic ketones is due to the absence of the aromatic nuclei.

141. Unsymmetrical Cyanines Derives from Azoles.

P. B. TRIPATHI and M. K. ROUT, Cuttack.

In this investigation, a number of unsymmetrical tri-, penta-, and hepta methin cyanines have been prepared with 5-phenyl 3-methyl, 1,3,4 thiadiazole as the fixed basic component, the second basic nucleus being one of the following:— (a) quinoline—2, (b) quinoline—4, (c) benzothiazole, (d) benzoxazole, (e) alpha-picoline. Their absorption maxima have been measured. These studies were carried out to determine, from the deviation data, the relative basicity of the various basic nuclei used as the second component. Another series of unsymmetrical tri-, penta- and hepta methin cyanines derived from 4-p-bromophenyl 2-methyl thiazole as the fixed basic nucleus and quinoline—2, and benzothiazole as the variable second component has also been studied and their derivations determined. The deviation data indicates that relative basicity of the various nuclei used as

the second component decreases in the following order : α -picolin > quinoline—4 > quinoline—2 > benzothiazole > benzoxazole.

142. Antispasmodic Compounds.

B. K. SABATA, P. B. TRIPATHY and M. K. ROUT, Cuttack.

Eight different series of compounds were prepared in this investigation with a view to examining their antispasmodic and antihistaminic properties. Four of these series were prepared by fusing anthranilic acid with following ketomethylene compounds in presence of sodium acetate (fused) at 140–60°C.

- (a) 3-Aryl-2-thiohydantoin.
- (b) 1-Aryl-3-methyl pyrazolone.
- (c) 2,4-thiazolidinedione.
- (d) Indanone.

To prepare the other four series of compounds, the nitrobenzylidene derivatives of the above four groups of ketomethylene compounds obtained by reaction with *o*-nitrobenzaldehyde in glacial acetic acid in presence of fused sodium acetate were used. Reduction of the resulting *o*-nitrobenzylidene derivatives by zinc dust and acetic acid resulted in formation of the desired products through ring closure.

The antispasmodic and antihistaminic properties of these compounds have also been evaluated and the results were significant.

143. Merocyanines derived from Pyrazolone.

B. K. PATNAIK and M. K. ROUT, Cuttack.

The present investigation includes the preparation of some mero-, merocarbo-, merodicarbo- and merotricarbo cyanines derived from 1-phenyl 3-methyl pyrazolone as the acidic nucleus and benzoxazole, benzothiazole, 4 aryl thiazoles, quinoline-2 and quinoline-4 as the different basic nuclei. The deviation in each case has been calculated which has rendered possible the evaluation of the relative basicity of the basic nuclei constituting the dyes under investigation.

144. Physico-chemical studies on crystalline α -globulin from Sesame seeds (*Sesamum Indicum*).

A. SEN and N. K. SINHA, Calcutta.

Crystalline α -globulin was prepared from sesame seeds of black, brown and white varieties according to the method of Jones & Gersdorff (J. Biol. Chem., 75, 213 (1927)). The material crystallises in the form of tetragonal bipyramids. Electrophoretic investigations were carried out in a Tiselius apparatus in the pH range 2.5–4.1 in acetate buffers of ionic strength 0.1. At higher pH values the material was found to be insoluble in buffers of low ionic strength. Single peaks were obtained at pH 3.23 and 4.1; at pH 2.5 two partially resolved peaks were obtained. Mobilities at pH 2.45, 3.23 and 4.10 were determined respectively as 6.66×10^{-5} (for the major component), 6.49×10^{-5} and 6.04×10^{-5} ($\text{cm}^2 \text{ v}^{-1} \text{ Sec}^{-1}$). Sedimentation analysis in a Spinco model E analytical ultracentrifuge at pH 6.7 in 0.062 M phosphate buffer containing 0.885 M NaCl showed the presence of two sedimenting components, the faster one being present in a very low concentration. The value of sedimentation coefficient $s_{20,w}$ for this was determined as 12.69s. Variable solvent solubility test according to the method of Falconer & Taylor (Biochem. J., 40, 835, 1946) was carried out at pH 6.7 in 0.2 M phosphate buffer containing

0.285 M NaCl with varying concentrations of ammonium sulphate at 20°C. The test also indicated the presence of a second minor component at this pH. The material does not appear to be homogeneous over the pH range studied. There was no difference in behaviour due to different variety of the seeds.

145. Optical Resolution and Reactions of 1-Naphthylphenyl-tolyl Carbinol.

K. A. THAKER and M. S. DAVE, Vallabh Vidyanagar.

Although some scores of secondary alcohols have been resolved into their optical isomers, usually by the crystallisation of the alkaloid salts of the hydrogen phthalates, it is only very recently that this method has been applied successfully to tertiary alcohols by Doering and Zeiss (J.A.C.S., 1950, 72, 147; *ibid*, 1951, 73, 2391). As a preliminary to the further work on the optically active tertiary alcohols, we have investigated the resolution of 1-naphthylphenyl p-tolyl carbinol of the purely aromatic in nature.

The phenylp-tolyl ketone prepared by Fridel & Crafts reaction gave the tertiary alcohol when treated with 1-naphthylmagnesium bromide. This carbinol in presence of triethylamine was made to combine with phthalic anhydride to give the hydrogen phthalate and this was resolved by the fractional crystallisation with the base of *l*-brucine to give the active hydrogen phthalates which by usual method of hydrolysis yielded the active carbinol.

146. Stereospecific Synthesis of methyl 6-p-anisyl-3-methoxycarbonyl-2-keto-3-methylcyclohexane-1-acetate.

D. K. BANERJEE and K. M. SIVANANDAN, Bangalore.

6-p-Anisyl-2-ketocyclohex-6-ene-1-acetic acid (I) was prepared by the condensation of β -dimethylamino-p-methoxypropionophenone hydrochloride with diethyl β -keto adipate. The methyl ester of I was formylated and reacted with hydroxylamine hydrochloride to yield methyl 5-p-anisyl-6,7-dihydrobenz [2, 1-d] isoxazole-4-acetate (II), which on treatment with potassium *t*-butoxide and methyl iodide furnished 6-p-anisyl-3-cyano-3-methyl-2-keto-cyclohex-6-ene-1-acetate (III). Partial saponification of ester, reduction of the resulting acid with lithium and liquid ammonia followed by esterification with methanolic hydrogen chloride gave methyl 6 p-anisyl-3-methoxycarbonyl-2-keto-3-methylcyclohexane-1-acetate (IV). The stereoselective conversion of IV to estrone has already been effected by Johnson, Christiansen and Ireland, *J. Am. Chem. Soc.*, 79, 1995 (1957).

147. On the constitution of mesuone—Part I.

D. P. CHAKRABORTY and P. K. BOSE, Calcutta.

Mesuone, a new antibiotic substance, m.p. 136° (Chakraborty, Purkayastha and Bose, Proc. Natl. Inst. Sc. India, 1959) was isolated from *Mesua ferrea* Linn. The studies on the constitution of mesuone have revealed the following.

(i) It is homogeneous, as indicated by paper chromatographic studies.

(ii) Tentative molecular formula of the compound suggested by Rast method is $C_{26}H_{44}O_4$.

(iii) The colour reactions of the compound show the presence of a phenolic or enolic hydroxyl group and unsaturation in it.

(iv) Infrared absorption spectrum of the compound shows the presence of (a) chelated hydroxyl, (b) carbonyl function in conjunction with a double bond,

(c) phenyl ring, (d) *gem*-dimethyl group and (e) monosubstituted benzene nucleus.

(v) the ultraviolet absorption spectrum of the compound shows band with λ max at 224 m μ (log ϵ 4.59) and 353 m μ (log ϵ 4.53).

(vi) The compound yields an acetyl derivative, m.p. 128° U.V. spectrum : λ max 248 m μ .

(vii) The compound yields on hydrogenation an oily product which could not be crystallised. The oil on alkaline cleavage yields a colourless alkali soluble compound m.p. 260° (U.V. spectrum : λ max 230, 250, 280, 325 and 340 m μ 's). The I.R. spectrum of the compound shows the presence of (a) hydroxyl (b) carbonyl function (c) *gem*-dimethyl group. The compound does not respond to ferric reaction.

(viii) The compound yields on alkaline cleavage formaldehyde and a phenolic compound, m.p. 210° (U.V. spectra : λ max 265 and 335 m μ).

Further studies are in progress.

148. On the antibiotic properties of some Natural Coumarins.

D. P. CHAKRABORTY, M. PURKAYASTHA and P. K. BOSE, Calcutta.

In continuation of our previous investigations on the antibiotic properties of natural coumarins and related substances (Chakraborty, Das Gupta and Bose, Ann. Biochem. Edptl. Med., 1957, 17, 59; Chakraborty, Purkayastha and Bose, Proc. Natl. Inst. Sc. India, 1959, 25B, 8), twenty natural coumarins and some of their derivatives were examined for their antifungal and antibacterial properties. The test organisms used were *Micrococcus pyogenes* var *aureus* (*Staphylococcus aureus*), *Bacillus friedlanderii*, *Escherichia coli*, *Eberthella typhosa*, *Vibrio cholerae*, *Mycobacterium phlei*, *Curularia lunata*, *Aspergillus niger*, *Helminthosporium sativum*, *Alternaria solani*.

It has been observed that some substances have antibacterial action while some are antifungal, but a few were found to be both antifungal and antibacterial. Seselin is fairly active against the fungus, *Curularia lunata*, as well as the bacteria, *S. aureus* and *M. phlei*.

149. Composition of the fatty oils obtained from the seeds of *Ocimum canum* and *Ocimum basilicum* by urea adduct method.

M. A. SHAIKH, V. G. SONAR and V. A. PATWARDHAN, Sangli.

The fatty oils obtained from the seeds of *Ocimum canum*, Sims, known in Marathi as Ran-Tulas and *Ocimum basilicum*, Linn, known in Marathi as Sabaja, from the plants grown on the premises of the Willingdon College, were saponified and the mixed fatty acids were separated from the unsaponifiable matter. The mixed fatty acids thus obtained were treated with urea in methyl alcohol and the following percentages of oleic, linoleic linolenic and saturated acids were obtained :—

The mixed fatty acids of *Ocimum canum* gave oleic 10.35, linoleic 58.06, linolenic 26.02 and saturated acids 4.65 and of *ocimum basilicum* found to be—oleic 12.52, linoleic 65.18, linolenic 17.85 and saturated acids 4.25.

The results obtained by urea adduct method support in general the composition obtained by bromination method.

150. Synthesis of some Heterocyclic compounds from 1-and 2-anthrol.

N. H. SHAH and SURESH SETHNA, Baroda.

The present work deals with the synthesis of γ -pyrone and furan derivatives from 1-and 2-anthrol. 2-Acetyl-1-anthrol and 1-acetyl-2-anthrol have been subjected

to the Kostanecki-Robinson acetylation and benzoylation and 2'-methyl- and 2-phenyl-1, 2- and 2,1-anthra- γ -pyrones have been synthesised. Further, the above ketones have been condensed with benzaldehyde in presence of alkali and the resulting dihydro γ -pyrones dehydrogenated to the 2'-phenyl- 1,2- and 2,1-anthra- γ -pyrones. 3-Methyl-anthra [1,2-b]-, 1-methyl-anthra [2,1-b]- and anthra [2,1-b]-furan have been synthesised from 2-acetyl-1-anthrol, 1-acetyl-2-anthrol and 1-formyl-2-anthrol respectively by condensation with ethyl bromoacetate and subsequent hydrolysis and ring closure of the anthroxyacetates formed.

151. Chloromethylation of some coumarin derivatives.

S. S. LELE and SURESH SETHNA, Baroda.

The chloromethylation of coumarins has been studied for the first time. 7-Methoxy-4-methylcoumarin on reaction with paraformaldehyde in presence of hydrogen chloride gave a mixture from which the 6-chloromethylcoumarin has been isolated. It has been reduced to the known 7-methoxy-4, 6-dimethylcoumarin and converted into the 6-formyl derivative through Sommelet reaction. The action of potassium cyanide, acetic acid and sodium acetate, and methyl alcohol has also been studied. The 3, 6-dichloromethyl, 3, 8-dichloromethyl and 3, 6, 8-trichloromethylcoumarins have been obtained using larger quantities of paraformaldehyde and their structures proved by reduction to the corresponding methyl derivatives which have been synthesised by unambiguous methods. 7-Hydroxy-4-methylcoumarin-6-carboxylic acid and its methyl ester on chloromethylation gave the 3, 8-dichloromethyl derivatives which on reduction gave the corresponding methyl derivatives. These have been degraded to 7-hydroxy-3,4,8-trimethylcoumarin.

152. Kostanecki-Robinson acylation of some iodo derivatives of 2:4- and 2:6-dihydroxyacetophenones.

M. V. SHAH and SURESH SETHNA, Baroda.

The Kostanecki-Robinson acylation of iodo derivatives of *o*-hydroxyacetophenones has not been studied so far. In the present work 3-iodo-, 5-iodo-, 3:5-diiodo-2:4-dihydroxyacetophenone and 3:5-diiodo-2:6-dihydroxyacetophenone have been subjected to Kostanecki-Robinson acetylation and benzoylation. The expected mono- and diiodo-3-acylchromones and flavones have been obtained except in the benzoylation of 2:4-dihydroxy-3:5-diiodoacetophenone where the iodine in the 3-position of the ketone is eliminated and only the 6-iodoflavone is obtained. The direct iodination of 7- and 5-hydroxy-3-acetyl-2-methylchromone and 7- and 5-hydroxy-3-benzoylflavone has also been found to give the 8-iodo- and the 6:8-diiodochromones and flavones.

153. Studies on 6:7-dihydroxy-4-methylcoumarin and its methyl ethers.

M. G. PATEL and SURESH SETHNA, Baroda.

The present work deals with the study of the pattern of substitution in the 6:7-dihydroxy-4-methylcoumarin(I) and its 7-methoxy(II) and 6:7-dimethoxy(III) derivatives.

On bromination with one mole of bromine all the three gave the 3-bromo compound but with 2-moles of bromine (I) and (II) gave the 3:8-dibromocompounds as seen by direct comparison with authentic specimens synthesized from 2-bromo-

resorcinol by unambiguous methods. (II) however gave the alternate 3 : 5-dibromo compound.

(I) did not give a definite product on nitration but (II) gave a mononitro derivative different from the authentic 8-nitro and 3-nitro compounds and hence was the 5-nitro derivative. (III) on nitration gave the 3-nitro derivative which on reaction with liquor ammonia gave 2-hydroxy-4 : 5-dimethoxy acetophenone. Negative results were obtained in the iodination and Friedel-Crafts acetylation of (I) and (II).

154. Studies in 3-Hydroxycoumarin derivatives.

K. N. TRIVEDI and SURESH SETHNA, Baroda.

Interest has been created in 3-hydroxy-and 3-aminocoumarins in recent years because of the observations that they inhibit growth of plants and have antibacterial properties. Various substituted 3-hydroxycoumarin derivatives have been synthesized in the present work by the condensation of 5-bromo-, 3 : 5-dibromo-, 3-nitro-, 5-nitro-, 3 : 5-dinitrosalicylaldehyde, methyl-2 : 4-dihydroxy-3-formylbenzoate and 2 : 4-dihydroxy-3-formylacetophenone with acetyl glycine in presence of sodium acetate and acetic anhydride and subsequent hydrolysis of the 3-acetamidocoumarins with alcoholic 3 N hydrochloric acid. The yields were good in the case of 5-bromosalicylaldehyde and 2 : 4-dihydroxy-3-formylacetophenone. In other cases the yields were poor.

The reactivity of 3-hydroxycoumarin(I) has been studied with bromine and iodine.

Friedel-Crafts acetylation of (I) and Fries migration of 3-acetoxycoumarin gave the same 4-acetyl-3-hydroxycoumarin.

(I) gave the 4-isonitroso derivative with nitrous acid, indicating the presence of the tautomeric ketonic structure in (I).

No definite product could be obtained on the nitration of (I).

155. Ullmann Reaction on some Iodocoumarins.

M. G. PATEL, S. S. LELIA and SURESH SETHNA, Baroda.

7-Hydroxy-, 7-hydroxy-4-methyl-, 7-hydroxy-6-carboxy-, and 7-hydroxy-6-carbomethoxy-4-methylcoumarin have been iodinated with iodine and iodic acid and the 8-iodocoumarin derivatives synthesized. The methyl ethers of these iodocoumarins when refluxed with copper bronze in diphenyl ether gave the corresponding di-coumaryl derivatives.

156. Studies on Colour and Constitution—Part I. Verification of Forster's and Knott's Rules.

B. K. PATNAIK, M. K. ROUT and P. K. JESTI, Cuttack.

Verification of Forster's and Knott's rule which correlate structural change at any point lying between two auxochromic atoms with light absorption of the concerned dye has been achieved with the help of the absorption maxima data of the following groups of compounds :

- (a) Unsymmetrical cyanines and their aza analogues.
- (b) p-Dialkylamino styryl dyes and their aza analogues.
- (c) Merocarbo cyanines and their aza analogues.
- (d) p-Dialkylaminobenzylidene derivatives of ketomethylene compounds and their aza analogues.

In applying the procedure the relative stability of the inter-auxochromic structures carrying C⁺ and C⁻ were at first evaluated. Replacement in the interauxochromic chain of the more significant ion (i.e. C⁺ or C⁻) by the corresponding ion of nitrogen (i.e. N⁺ or N⁻) resulted in either hypsochromic or bathochromic shifts and this rendered possible verification of the above rules as well as the assessment of the relative acidity and basicity. These new groups of compounds were specially designed and prepared by us for the above purpose.

157. Action of Hydrazine Hydrate on Esters of Coumarin-3-Carboxylic Acid.

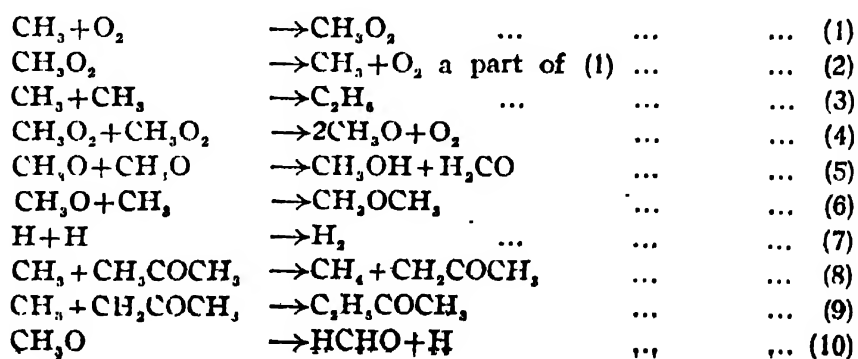
C. N. HAKSAR, Gwalior.

Attempts were made to prepare the hydrazide of coumarin-3-carboxylic acid, by the action of hydrazine hydrate over the methyl or the ethyl esters of the acid or its acid chloride, but were unsuccessful. Baker, Haksar and McOmie (*J. Chem. Soc.*, 1950, 170) had also used this general method for the preparation of hydrazides of coumarin carboxylic acids and obtained satisfactory results. They, however, found that methyl or ethyl coumarin-3-carboxylate behaved in a peculiar manner and did not yield the expected hydrazide under identical conditions but *o*-hydroxybenzylideneazine (salazine) and malonic dihydrazide were produced in either case. Coumarin 3-carboxylic acid chloride also gave salazine under these conditions. The reaction has been thoroughly investigated. There are instances in the literature where the pyrone ring of the coumarin nucleus undergoes fission under the influence of the strongly basic hydrazine and a molecule of hydrazine further adds across the double bond at the β -carbon atom. Thus with the esters of coumarin-3-carboxylic acid an intermediate product is formed which then breaks up to give malonic dihydrazide and the hydrazone of salicylaldehyde. The latter compound at higher temperatures is readily converted into salazine. The truth of this assumption for the actual course of the reaction was confirmed by the isolation of the hydrazone of salicylaldehyde during the course of the reaction.

158. On the oxidation of methyl radical.

A. N. BOSE, Lucknow.

Oxidation of methyl radicals formed from the thermal decomposition of ditertiary butyl peroxide at different temperature was studied by static method and the products of the reaction were analysed by mass-spectrometer at Oxford. The following mechanism for the oxidation process at high temperature has been suggested. It is for the first time reported that in presence of oxygen ethane can form at high temperature.



159. Occurrence of Auraptene and Lupeol in the root of *Aegle marmelos* Corrêa.

B. CHAUDHURY and A. CHATTERJEE, Calcutta.

Auraptene (7-geranoxycoumarin) and lupeol have been isolated from the root of *Aegle marmelos* Corrêa besides three other components, viz., marmin (7-3:7-dihydroxy-3:7-dimethyloctyloxy} coumarin), skimmianine (4:7:8-trimethoxyfuranoquinoline) and umbelliferone. The oil left after the separation of the last three components (Proc. Ind. Sci. Cong., 1959, 142) from an ether extract of the root of the plant was dissolved in benzene. Chromatography of benzene solution followed by elution of the chromatogram with the same solvent yielded auraptene (yield, 0.0087%) and lupeol (yield, 0.12%). Auraptene, $C_{18}H_{22}O_3$, m.p. 71° was purified by several crystallisations from methanol and lupeol, from ethyl acetate. Further elution with ethyl acetate furnished marmin in small quantities (0.02 %).

160. Conversion of Yohimbine to β -Yohimbine.

S. GHOSAL and A. CHATTERJEE, Calcutta.

Epimerization of yohimbine to β -yohimbine (at C_{17}) was accomplished earlier by Godtfredsen and Vangedal (Acta Chem. Scand., 1957, 11, 1013), Le Hir and Warnhoff (Compt. rend., 1958, 246, 1564) and Diassi and Dylion (J. Amer. Chem. Soc., 1958, 80, 3746). It appeared to the present investigators that such inversion can be readily induced by a strong hydrogen acceptor in presence of any alkoxide ion when the corresponding β -keto ester will be formed. The latter upon stereospecific reduction with sodium borohydride would produce the desired thermodynamically stable C_{17} -epimer. The reaction would be initiated by proton transfer from the alkaloid to the hydrogen acceptor.

Based on this idea yohimbine was refluxed with fluorenone and sodium methoxide in dry benzene for 20 hours. Yohimbinone, $C_{21}H_{24}N_2O_3$, m.p. 256° , dec. was obtained in practically quantitative yield. It formed orange-red needles of D.N.P.H. sulphate, m.p. 290° , dec. Yohimbinone upon reduction with sodium borohydride in methanol yielded β -yohimbic acid which was converted into β -yohimbine by methylation with dry methanolic hydrochloric acid (an overall yield, 30%).

161. Synthesis of Rhetsinine, an Indolequinazoline Alkaloid of *Zanthoxylum rhetsa* DC.

A. CHATTERJEE and J. MITRA, Calcutta.

Rhetsinine, $C_{18}H_{17}O_2N_3$, m.p. 192° (dec.), is an optically inactive, yellow, carbinolamine base of *Zanthoxylum rhetsa*. The constitution of this alkaloid was proposed from the studies of its properties and several degradation reactions.

The synthesis of rhetsinine has been achieved by the present investigators by an unambiguous method which proves the validity of the structure advanced for rhetsinine.

For the desired synthesis N-methyl anthranilic acid was converted by ethylchloroformate into N-methylisatoic anhydride. It reacted with tryptamine forming 3- β -O-methylaminobenzoyl-aminoethylindole. The latter upon subsequent condensation with ethyl orthoformate furnished dl-evodiamine, a colourless base, $C_{18}H_{17}ON_3$, m.p. 272° , dec.

To an acetone solution of evodiamine, 100% aq. KOH was added. The alkaline solution was oxidised by permanganate (in acetone) at 0° . The yellow rhetsinine

chloride, $C_{10}H_{16}N_2O$ Cl, decomposing at 220° and melting at 243° , was prepared. An aqueous solution of rhetsinine chloride upon basification with sodium carbonate gave rhetsinine, which crystallised from chloroform and finally from alcohol in yellow leaflets, $C_{10}H_{17}O_2N_2$, m.p. 192° (dec.) (yield, 20% of the theoretical). It was identical with the natural product, rhetsinine, in every respect and their absorption spectra both ultraviolet and infra-red were superimposable.

The oxidation has proceeded at C_3 is proved by the fact that (a) scission products of the synthetic base during alkali hydrolysis were dihydropyrid-(3-4-b)-indole-1-one and N-methylantranilic acid and that (b) reduction of the base with sodium borohydride furnishes dl-evodiamine.

162. Studies on the Constitution of a New Lactone Fraxinifolin, isolated from *Evodia fraxinifolia* Hook.f.

SUNIL KUMAR TALAPATRA, Calcutta.

From an ether extract of the stem-bark of *Evodia fraxinifolia* Hook. f. (fam. Rutaceae), a new lactone, designated as 'fraxinifolin', has been isolated in pure and homogeneous state. It crystallises from alcohol in colourless glistening needles, m.p. $279-80^\circ$ (dec.) $[\alpha]_D^{29} = -101.5^\circ$ (C. 1.33 in chloroform) and -89.1° (C. 2.11 in pyridine). The molecular formula by Rast's method is $C_{28}H_{32}O_8$ (although the formula $C_{28}H_{30}O_8$ cannot be ruled out at the moment). The equivalent weight, (237), indicates the presence of two lactone rings. It is free from methoxyl and methylenedioxy groups and contains two active hydrogen atoms and at least two C-methyl groups and shows the absence of acetyl or ester groups. Ehrlich's reagent suggested the presence of a β -substituted furan ring which is also supported by spectral analyses. The absorption peaks support the presence of O-H, conjugated ethylenic double bond and ether bridge (of furan) respectively, and the bands at 1386 and 1365 cm^{-1} might be due to the presence of a gemdimethyl function. Fraxinifolin exhibits such peaks as could be associated probably with the $C=O$ stretching vibrations of a saturated γ -lactone and δ -lactone respectively. A ketonic carbonyl has been confirmed by the spectrum and the formation of an oxime. The formation of O, O-diacetyl derivative, $C_{28}H_{30}O_8(COCH_3)_2$, indicates the presence of two hydroxyl groups in the parent substance thus accounting for the two active hydrogen atoms observed. From these observations the eight oxygen atoms in this compound have been accounted for. Reactions with bromine and hydrogen have been studied.

Work on the hydrogenation products and on the constitution of fraxinifolin are in progress.

163. Studies on the Resolution of Aegeline, An Alkaloid-Amide of *Aegle marmelos* Correa.

S. K. SRIMANY and A. CHATTERJEE, Calcutta.

Aegeline (N- $\{\beta$ -hydroxy- β -p-methoxy $\}$ phenylethyl-trans-cinnamamide), $C_{18}H_{20}O_4N$, m.p. 176° isolated from the leaves of *Aegle marmelos* Correa is optically inactive although it contains an asymmetric carbon atom. This property has been suggested to be due to the geometrical stereochemistry of the molecule or due to spontaneous racemisation of the optically active N- $\{\beta$ -hydroxy- β -p-methoxy $\}$ -phenylethylamine, the basic component of aegeline. The latter alternative appears to be more plausible from the following investigation. dl-N- $\{\beta$ -Hydroxy- β -p-methoxy $\}$ phenyle-

thylamine upon resolution with d-camphor- β -sulphonic acid from acetone solution yields d-camphor- β -sulphonate of one enantiomorph, m.p. 169° , $[\alpha]_D^{27} = +15.3^{\circ}$ in water, in preponderant quantity (90%) which shows that asymmetric transformation proceeds during this resolution. The base liberated from the above salt under mild conditions crystallises from methanol in stout transparent rods. It is extremely hygroscopic, melts at 40° but soon solidifies, the m.p. of the solid mass being 72° (same as that of the dl-base). The base liberated from d-camphor- β -sulphonate shows no optical rotatory power and upon condensation with trans cinnamoyl chloride yields dl-aegeline. Further studies on the resolution of the base by other methods are underway.

164. Synthesis of Bergamottin.

A. CHATTERJEE and B. CHAUDHURY, Calcutta.

Bergamottin (5-geranoxy psoraline), $C_{21}H_{32}O_6$, m.p. 59° , was isolated by Späth and Kainrath in 1937 from Bergamot oil (Chem. Ber. 70, 2272, 1937) prepared from (*Citrus bergamia* Risso. We have been able to synthesise bergamottin. The starting material for the purpose is bergaptol m.p. 280° . It was prepared according to the method of Späth and Kubiczek (Chem. Ber. 70, 1253, 1937). Bergaptol was refluxed for eight hours with geranyl chloride prepared according to the method of Forster and Cardwell in presence of sodium ethoxide in absolute alcohol. The reaction product was freed from the solvent under vacuum. The ether soluble portion of the residue was washed with 5% aqueous alkali to remove unreacted bergaptol, concentrated and chromatographed on alumina followed by elution with ether. Bergamottin appeared in earlier fractions. It crystallised from ethanol in colourless flakes, m.p. 58° , yield, 7.5%. Elementary analyses were in excellent agreement with the formula $C_{21}H_{32}O_6$. It suffered thermal decomposition at 200° forming bergaptol, m.p. 280° and the latter upon methylation with diazomethane formed bergapten, $C_{12}H_{14}O_4$, m.p. 188° .

165. Studies on 2-Benzylidine-4-Quinazolones prepared from Anthranilamides and Phenylacetic acid.

S. K. ROY, S. GHOSH MAJUMDAR and A. CHATTERJEE, Calcutta.

It was observed that N_1 -methyl-anthranilamide reacted with phenylacetic acid to produce N_1 -methyl-2-benzylidine-1:2-dihydro-4-quinazalone.

As a test for the general applicability of this reaction in the preparation of 2-benzylidine-4-quinazolones, further synthetic experiments have been performed. It has been possible to demonstrate that the reaction is a general one and anthranilamides with or without substitution at N_1 upon interaction with phenylacetic acid always provide 2-benzylidine-4-quinazolones but not their 2-benzylcompounds, although the former regenerate phenylacetic acid during their alkali hydrolysis. The latter originates from the quinazolones by a reversible reaction.

Several 2-benzylidine compounds have been prepared e.g. (1) N_1 -methyl-2-benzylidine-4-quinazalone, m.p. $155-56^{\circ}$, (2) 2-benzylidine-4-quinazalone, m.p. 250° , (3) N_1 -methyl- N_3 -phenyl-2-benzylidine-4-quinazalone, m.p. 165° and (4) N_3 -phenyl-2-benzylidine-4-quinazalone, m.p. 112° from phenylacetic acid and their appropriate anthranilamides according to the method of Chatterjee and Ghosh Majumder. Direct evidence for benzylidine moiety in their molecules has been obtained by appropriate reactions and confirmed by infra-red absorption at 6.2μ (for exocyclic double bond).

166. Tinosporine, the New Bitter Principle of *Tinospora cordifolia* Miers.

A. CHATTERJEE and S. GHOSH, Calcutta.

Tinosporine is the neutral bitter principle of the root of *Tinospora cordifolia* Miers (Fam. *Menispermaceae*). The compound (yield, 0.02%) is soluble in methanol and ethanol and insoluble in other organic solvents. Tinosporine crystallises from methanol in prismatic leaflets. Elementary analyses of the compound, m.p. 254° (dec.) suggest its composition as $C_{21}H_{28}O_6$, which is in good agreement with its molecular weight determined by the method of Rast. It is optically active and is free from carbomethoxyl and methylene-di-oxy groups. The presence of a hydroxyl and a furan ring is strongly indicated by the infrared ((Nujol) spectrum of the compound. In the carbonyl region it has two strong bands showing an unconjugated ketone, characteristic absorption of which is discernible in the u.v. region (270 $m\mu$). A lactonic function is also evidenced. The absorption maxima in the far ultraviolet (210 $m\mu$; in ethanol) ϵ , 7540 suggests that tinosporine contains a furan ring, an unconjugated ketone, a hydroxyl and a six membered lactone. Further work on this compound is in progress.

167. Role of Electronic, Steric and other Factors in Dieckmann Cyclisation : The Cyclisation of Ethyl 2-Methylpentan-1,2,5-tricarboxylate.

JADUGOPAL DUTTA and RABINDRA NATH BISWAS, Calcutta.

The cyclisation of ethyl 2-methyl-pentan-1,2,5-tricarboxylate, has been investigated in polar and non-polar solvents and at temperatures ranging from 80-135°. The chief product on hydrolysis of the resulting β -keto ester was 1-methyl-2-oxo-cyclopentylacetic acid, rather than the isomeric 1-methyl-3-oxo-cyclohexanecarboxylic acid. This finding is in harmony with the observations of Chakravarty and Banerjee. A mechanism is proposed to explain the ease of formation of 1-Me-2-oxo-cyclopentyl Ac. acid rather than 1-Me-3-oxo-cyclohexane Carb. acid in light of the conformational analysis of the transition states.

The transition state for the sixmembered cyclisation product involves a strong 1,3-diaxial interaction, where as in the transition state of the five-membered product no such significant interaction can be observed. Arguments of Chakravarti based on the positive (electron releasing) character of the methyl group does not seem to be satisfactory in the light of the mechanism suggested.

168. Hydrolysis of Indian *Dioscorea* with Saponases.

R. N. CHAKRAVARTI, (Mrs.) D. CHAKRAVARTI and M. N. MITRA, Calcutta.

As a result of a survey of the yams of Indian *Dioscorea* plants carried out in our laboratory it was possible to discover two rich Indian sources for diosgenin, viz., *Dioscorea deltoidea* (Kins) of Kashmir and *Dioscorea prazeri* (Kukurtoral) of Darjeeling. A simplified method was also developed for isolation of diosgenin from these yams. Later Rothrock, Hammes and McAleer isolated diosgenin from *D. barbasco* by the direct hydrolysis of the dried powdered yams with hydrochloric acid and subsequent extraction of the crude hydrolysed mass with a solvent. Recently this method was applied by Vishwapal, Handa and Chopra in the case of *D. deltoidea* and by us in the case of *D. prazeri*. The method has one disadvantage, however, as significant amount of 25D-spirosta-3:5-diene is formed by the action of hydrochloric acid on diosgenin.

Wall and Krider demonstrated that agave juices contain saponases suitable for conversion of *Dioscorea* saponin to sapogenin. We tried this method for isolation of diosgenin from *D. prazeri* and *D. deltoidea*, and the details of process have been

described. Crystalline residues were obtained in both cases. In the case of *D. prazeri*, the residue on further purification by crystallisation from alcohol gave diosgenin, m.p. 203-4°; yield, 2.8%. In the case of *D. deltoidea*, however, the crystalline residue on further purification by crystallisation from alcohol gave a product, m.p. 180-182°. This product is still under investigation.

169. Caustic Potash Fusion of 1-Methyl Indole and 1:2-Dimethyl Indole.

S. BOSE, Kanpur.

1-methyl indole and 1:2 dimethyl indole upon fusion with caustic potash at 300° for five minutes produces respectively indole and indole-2-Carboxylic acid. This demonstrates that during alkali fusion, elimination of methyl group associated with indole nitrogen atom takes place, as a result of which N-methyl indole and its derivatives always furnish indole compounds and not Ind-N-methyl substances. The above observation is in conformity with our previous finding in case of rauwolfinine, the alkaloid of *Rauwolfia serpentina* Benth. Rauwolfinine on caustic potash fusion furnishes harman and not Ind-N-methyl harman.

170. Studies on Indigoid Dyes.

J. C. BANERJI and ARUN KUMAR SINHA, Patna.

Three new dyes have been synthesised by the condensation of 5-iodothiaindoxyl with β -naphtho-quinone, glyoxal sodium bisulphite and terephthallic aldehyde.

Their absorption and other properties have been studied.

171. A Synthesis of Octahydrodemethoxydeoxydeacetamidocolchicine.

D. NASIPURI, (Miss) U. RAKSHIT and (Miss) M. GUHA, Calcutta.

'Colchicine was degraded to octahydrodemethoxydeoxydeacetamidocolchicine by Rapoport *et al*, under conditions in which any rearrangement could possibly be excluded. It was felt that a synthesis of this compound, which contains the intact carbon skeleton of colchicine, would definitely establish the seven-membered tropoloid nature of ring C. So far all attempts to synthesise this compound however, failed.

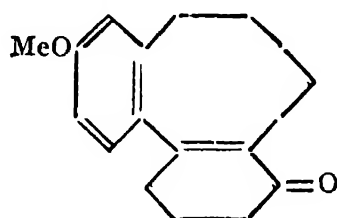
During our investigations of seven-membered ring compounds, we found that ethyl α -(γ -3 : 4 : 5-trimethoxyphenylpropyl)- β -oxosuberate could be cyclised to the dicarboxylic acid by polyphosphoric acid. The corresponding ester on Dieckmann cyclisation and subsequent hydrolysis yielded the ketone, which, on Huang-Minlon reduction, gave the desired compound in good yield. The identity of this compound with that derived from colchicine was established from m.p. determination, identical infra-red and ultra-violet absorption spectra and formation of identical epoxide.

172. Synthesis of Seven-membered Ring Compounds. Part II.

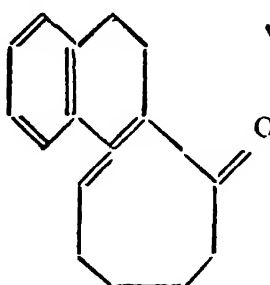
R. ROY, (Miss) U. RAKSHIT and D. NASIPURI, Calcutta.

'In continuation of our synthetic investigations in seven-membered ring compounds, we found that Bougault's type of cyclisation of appropriate β -oxoesters could be conveniently utilised for the synthesis of polycyclic systems containing one or two seven-membered rings. For this purpose, γ -*m*-methoxyphenylpropyl bromide was condensed with ethyl β -oxipimelate and the resultant β -oxoester was cyclodehydrated with polyphosphoric acid to give the dicarboxylic acid, the dimethyl ester of which

on Dieckmann condensation and subsequent hydrolysis yielded the ketone (V). Similarly α -phenethyl- β -oxosuberate on cyclodehydration with concentrated sulphuric acid at 0° gave δ -(2-carboxy-3:4-dihydro-1-naphthyl) valeric acid, m.p. $124-125^\circ$ in 70% yield, which on cyclisation through the corresponding ester yielded the ketone (VIII). It is expected that by combination of these two methods, tricyclic systems with two seven-membered rings will be made available.'



(V)

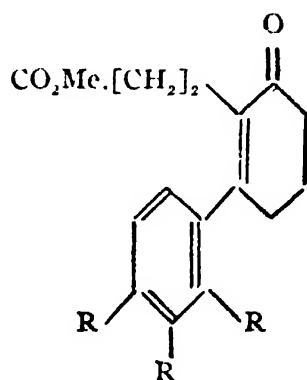


(VIII)

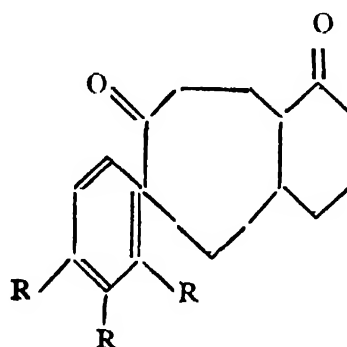
173. Synthesis of Seven-membered Ring Compounds. Part I.

(Miss) M. GUHA and D. NASIPURI, Calcutta.

'In view of the importance of seven-membered ring compounds in the studies of colchicine and analogues, we were interested in the preparation of polycyclic systems with one or more seven-membered rings. As an extension of the syntheses of hydrochrysene and hydrophenanthrene derivatives we condensed the methiodide of β -dimethylaminopropiophenone with the potassium derivative of ethyl β -oxopimelate. The product on hydrolysis and esterification yielded the methyl ester (III, R=H) in about 50% yield. The latter was reduced catalytically and hydrolysed to the corresponding propionic acid. Similar series of reactions with the Mannich base of 2:3:4-trimethoxyacetophenone gave the unsaturated ester (III, R=OMe) which was reduced, hydrolysed and the acid cyclised to the diketone (V) by treatment with polyphosphoric acid.'



(III)



(V)

174. Studies on Insecticides, Part I: Preparation of some analogues of D.D.T. and their Derivatives.

J. K. MEHROTRA, (Miss) M. NANDI, A. K. SIRKAR, S. K. SUKHLA, J. P. TEWARI, S. D. VERMA and A. N. DEY, Kanpur.

The object of this series of papers is to communicate the preparation and properties of some of the analogues of DDT with a view to elucidate the relationship between structure and their biological activity. A large number components have been described.

175. Chemical Examination of the leaves of *Sesbania grandiflora*.

R. D. TIWARI, P. C. GUPTA and S. S. KHANNA, Allahabad.

Sesbania grandiflora Linn, belongs to Papilionaceae, sub-group of the Leguminosae family. The ethanolic extract of the dried leaves on keeping deposited a white flocculant solid which after crystallisation from ethanol and recrystallisation from chloroform gave an aliphatic keto- δ -lactone $C_{24}H_{44}O_4$ melting point $82^\circ C$. On boiling with hydriodic acid it gave $C_{21}H_{43}O_4I$ and with hydrobromic acid $C_{24}H_{43}O_4Br$. On esterification with methanol in presence of sulphuric acid it gave $C_{23}H_{48}O_4$ which was found to contain a hydroxyl group and on acetylation gave $C_{25}H_{47}O_4(COCH_3)$. The presence of a ketonic group was indicated by the formation of a 2 : 4 dinitro phenyl hydrazone. When oxidised it gave palmitic acid and another dibasic acid $C_8H_{14}O_4$.

The existence of a δ lactone structure is confirmed by presence of a peak at 5.777 in the I. R. Spectrum, a ketonic group by peaks at 6.057, 6.825 and 7.26 of

$$\begin{array}{c} CH_3 \\ | \\ -C- \end{array}$$
 groups by peaks at 3.485, 6.324, 6.892 and 7.26.

176. Reactions of Vanadium Tetrachloride with Alcohols.

R. K. MULTANI, Delhi.

Vanadium tetrachloride reacts with alcohols in cold benzene forming the dichloride dialkoxide alcoholates $VCl_2(OR)_2$, ROH where R=Me, Et, Pr^n , Py^n , Bu^n Bu Bu and n-pentyl. Under more vigorous conditions and especially with tertiary alcohols, hydrolytic side reactions occur. Heating the dichloride dialkoxide alcoholates at $150^\circ/0.1$ mm. formed vanadium oxychloride alkoxides, $V_2OCl_3(OR)_2$. These alcoholates were dimeric in boiling benzene, suggesting hexaco-ordinated vanadium. These alkoxides exchanged alkoxide groups with alcohols.

177. Reactions of Molybdenum pentachloride with Alcohols.

R. K. MULTANI, Delhi.

Molybdenum pentachloride reacts with alcohols forming the dimeric trichloride dialkoxides $MoCl_3(OR)_2$ where R=Me, Et, or Pr^n in which molybdenum is probably hexaco-ordinated. These compounds decomposed at temperatures above 80° in vacuo and gave molybdenum oxychloride alkoxides. These alkoxides exchanged alkoxide groups with alcohols.

178. Study in Several 5-Chloroacridines and Benzacridines.

M. H. ANTANI and A. G. MUNSHI, Bhuj—(Kutch).

In order to study the effect of Halogen substituents in the nucleus with and without OCH_3 group, several substituted diphenylamine-2-carboxylic acids, some of which are unknown, are cyclised by $POCl_3$. Similarly, two 5-chlorobenzacridines are also synthesised, where additional fused benzene ring may be supposed to affect the stability. It is found that the 5-chloroacridines when prepared from 2' : 4'- and 2' : 5'- dichloro-4-methoxydiphenylamine-2-carboxylic acids on treatment with $POCl_3$ gave no corresponding acridones. 3' : 5'-dichloro-4'-methoxy-diphenylamine-2-carboxylic acid and 3'-5'-5-trichloro-4'-methoxydiphenylamine-2-carboxylic acids yield a small amount of 5-chloroacridine, the most of the acid being converted into acridone; while 1' : 4'- and 2' : 5'-dichlorophenylamine-2-carboxylic acids gave the correspond-

ing acridones only. In the case of benzacridines, acridone formation was not observed; but 5-chlorozenzacridines were the products. It seems that methoxy group in the acridine nucleus and additional fused benzene ring in the case of benzacridines give stability to the compounds.

179. Studies on Insecticides, Part I : Preparation and studies of the properties of some D.D.T. analogues and their Derivatives.

J. C. ROY and J. D. TEWARI, Allahabad.

A considerable amount of literature exists on the mode of action of DDT and attempts have been made by different authors to it with the type of chemical changes which DDT undergoes during the metabolic changes involved. But no such information exists for the analogues of DDT. Since such information would be helpful for the understanding of the relationship between the constitution and the biological activity of such compounds attempts are being made to make a systematic study of these compounds from this aspect. In this paper the experiments carried out with 2, 2-(p-bromophenyl)-1, 1, 1-trichloro ethane (A) on dehydrochlorination gave 2, 2-(p-bromo phenyl)-1, 1-dichloro ethylene which on oxidation with chromic acid in acetic acid furnished p, p-bromo benzophenone. On nitration A gave both the di-nitro and the tetra nitro derivatives. The former on reaction with sodium methylate gave the corresponding dimethoxy compound formed by the replacement of the bromine atoms by the methoxy groups and was confirmed to be identical with the same derivative obtained by Shirley et al (J.A.C.S., 1949, 71, 3173).

Action on Carbonic anhydrase as determined by the method of H. Keller has shown that none of the above compounds except 2, 2-(p-bromo phenyl)-1, 1, 1-trichloro-ethane has any action on this enzyme system. The action of the latter was however similar to what is observed with DDT on the same enzymic system.

180. Electrolytically Regenerated Manganic Sulphate for the Oxidation of Aromatic Hydrocarbons. Part I : Oxidation of Toluene to Benzaldehyde.

M. S. VENKATACHALAPATHY, R. RAMASWAMY and H. V. K. UDUPA,
Karaikudi.

It has been shown that when oxidation of toluene is carried out in the electrolytic cell itself using manganous sulphate as an "oxygen carrier", poor current efficiency for benzyldehyde is obtained for long duration of electrolysis.

Good efficiency for benzaldehyde is obtained when toluene is oxidized separately at a temperature of 50-60°C by reacting with manganic sulphate produced electrolytically.

By using a paste of manganous sulphate in sulphuric acid, manganic sulphate reagent is obtained in a concentrated form so that the volume of sulphuric acid to be handled to produce a pound of aldehyde is reduced to a minimum.

The process of oxidation of toluene to benzaldehyde is made cyclic and continuous by regeneration of manganic sulphate at the anode, after a vacuum treatment for the electrolyte paste of manganous sulphate.

181. Studies on Jaborandi Alkaloids, Part IV : The Preparation of analogues of pilocarpidine, pilocarpine and iso-pilocarpine.

J. K. MEHROTRA and A. N. DEY, Kanpur.

In a previous communication we have described a general method for the preparation of jaborandi alkaloids. In the present paper the same has been utilised for the preparation of analogues of some of these products.

For the purpose Ethyl phthalimide ethyl acetoacetate, prepared from phthalimide acetyl chloride and ethyl malonate (see also Dixit, Verma, Malhotra and Dey, Ind. Sci. Congr. Abstracts, 1959), was condensed with 1-ethoxy-3-cyano-2-propene and the resultant product was hydrolysed giving the analogue of homopilopyl amine methyl ketone. This on condensation with potassium thiocyanate gave a good yield of the 2-thiol pilocarpidine, which on oxidation with ferric chloride furnished the corresponding analogue of pilocarpidine. On methylation with methyl iodide it gave in turn the corresponding analogue of pilocarpine and *iso*-pilocarpine. Further work on the preparation of other analogues is under progress.

182. Aniline and p-Toluidine Salts of Ethyl-Xanthic Acid.

R. H. SAHASRABUDHEY, J. RUPCHAND and S. VASISTHA, Varanasi.

Chemistry of certain alkylammonium ethylxanthates has been described by Nambury. By the interaction of aniline and p-toluidine with free ethylxanthic acid, phenylammonium- and p-tolylammonium ethylxanthates have now been obtained: $\text{EtO.CS.SHNH}_2\text{Ar}$. Like aliphatic aminexanthates they decompose on pyrolysis above their melting points. A quantitative study of this has been carried out. Ethyl-alcohol and carbondisulphide and small quantities of hydrogensulphide are evolved as gaseous product. The residue was found to consist of considerable quantities of the related symmetrical diarylthiocarbamide, the thiourethane and what appears to be the related arylammonium salt of aryldithiocarbamate. This last gave a characteristic Doulevy derivative and decomposed on treatment with alkali in the expected quantity of aniline or p-toluidine. On prolonged heating the yields of the diarylthiocarbamide were not found to show any marked increase which was perhaps suggestive of the minor role that phenylammonium phenyldithiocarbamate plays as an intermediate in the carbondisulphide-aniline reaction. Further work is in progress to elucidate the above reaction and the mechanism of $\text{CS}_2\text{-ArNH}_2$ reaction in general.

183. On Thiodiazole Oxidation Products of Thioureas.

K. S. SURESH, S. PUSHPAMMA and R. TRIPATHI, Varanasi.

The hydrolytic decomposition of the "thiodiazoles" from NN'-di-p-tolylthiourea and N-phenyl-N'-p-tolylthiourea has been studied. The results once again confirm the earlier observations and suggest the probability that the compounds may in reality be benzthiazole derivatives. The details of the reactions and treatments have been discussed in this paper.

184. Some further Reactions of Tetraphenyl Formamidine Monosulphide Hydrobromide.

K. S. SURESH, Varanasi.

The tetraphenyl formamidine monosulphide hydrobromide when treated with bromine in chloroform gave a perbromide $\text{C}_{26}\text{H}_{22}\text{N}_4\text{S Br}_4$. When this perbromide was reduced with a strong aqueous potassium iodide solution in presence of chloroform decomposition products of the monosulphide hydrobromide *viz.*, triphenylguanidine and phenylisothiocyanate were found in the chloroform layer but not the "thiodiazole" from which it is evident that the perbromide is of the monosulphide hydrobromide. However, on treatment of the monosulphide hydrobromide with bromine in alcoholic medium no perbromide separated; subsequent basification gave Hagershoff's thiodiazole in good yield.

Perbromide from the hydrobromide of Hegershoff's thiodiazole (3:5 diphenylimino-2:4-diphenyl-1:2:4 thiodiazole), prepared by treating the hydrobromide with bromine in a mixture of benzene and chloroform, proved to be a mixture of perbromides, and was not identical with that obtained from the monosulphide hydrobromide.

By the action of thionylchloride on the monosulphide hydrobromide in chloroform a trace of 2-phenylaminobenzthiazole and a large quantity of another product was obtained which could not be purified. Reactions with the product suggested that the compound most probably is an addition product of thionylchloride and monosulphide hydrobromide.

185. 2-Arylguanidobenzthiazole and Thiodiazole Isomerides of Certain Hector's Bases.

K. S. SURESH and C. P. JOSHUA, Varanasi.

Hector's bases are most easily formed by the oxidation of N-aryl or NN'-diaryl thiocarbamides. The one obtained from phenylthiocarbamide is believed to be 2:4-diphenyl-3:5-diimino-1:2:4-thiodiazole. But this structure is yet unconfirmed. There are many other "thiodiazole" possibilities and besides, since the arylthiocarbamides easily form benzthiazoles by oxidation, it was not unlikely that Hector's bases were benzthiazole derivatives. Out of the two probable benzthiazole derivatives isomeric with the above "thiodiazole", viz., 3-phenylformamido-2-iminobenzthiazole and 2-phenylguanidobenzthiazole, the latter was synthesised by condensing in presence of lead oxide (i) N-phenyl-N'-(2-benzthiazolyl) thiocarbamide with alcoholic ammonia and (ii) phenylthiourea with 2-aminobenzthiazole; m.p. 155°.

The formation of a new Hector's base $C_{20}H_{16}N_4S$ m.p. 169° by the bromine oxidation of a mixture of phenylthiourea and thiocarbamide was reported in these abstracts (1959, p. 135). Isomeric benzthiazole derivative: 2-diphenylguanido benzthiazole m.p. 135° was prepared by condensing in presence of yellow lead oxide (i) N-phenyl-N'-(2-benzthiazolyl) thiocarbamide with aniline and (ii) 2-aminobenzthiazole with thiocarbamide. Another isomeric compound 3:5 diphenylimino-2-phenyl-1:2:4-thiodiazole was obtained by the oxidation of N-diphenylformamido-N'-phenylthiourea, m.p. 133° (Found C 70.17, H 4.99, N 16.71, S 10.2%, calc. for $C_{20}H_{16}N_4S$, C 69.7, H 4.6, N 16.28, S 9.3%). Both these compounds were found different from the above referred to base, m.p. 169°. Further work is in progress.

186. Interaction of Aromatic Amines with Aryl-substituted Thiurets.

S. N. DIXIT, Varanasi.

The interaction of aromatic primary amines with arylsubstituted thiurets has been reported to give "arylguanido arylthiocarbamides". Suresh (Current science; a note under publication) has recently shown that the product of the reaction of aniline and phenyl thiuret is 3:5-diphenylamino-1:2:4-thiodiazole and not "phenylguanido phenylthiocarbamide" as reported by Fromm & Vetter. The reaction has now been examined with the following pairs of reactants; (i) p-tolylthiuret and p-toluidine, (ii) p-tolylthiuret and aniline, (iii) p-phenetylthiuret and aniline and (iv) Phenylthiuret and p-phenetidine. It has been found that if the reaction is allowed to proceed for a short duration of time only (15 minutes) at waterbath temperature, the main product of the reaction is N-arylformamido-N'-arylthiocarbamide. The identity of this has been confirmed in every case by synthesis from appropriate arylguanidine and arylisothiocyanate. If the reaction is carried out for a longer time the main product is 3:5-diarylamino-1:2:4-thiodiazole which is

identical with the thiodiazole obtained by the oxidation of the above referred to related N-arylformamido-N'-arylthiocarbamide. The mechanism of the reaction has been discussed.

It is further found that the so-called anhydroacylarylguanido arylthiocarbamides described by Fromm and coworkers are identical with the above referred to related thiodiazoles.

187. Interaction of Isopersulphocyanic Acid with Methyl Amine.

S. N. DIXIT, Varanasi.

The interaction of isopersulphocyanic acid with aromatic amines is known to give arylsubstituted dithiobiurets. The reaction has now been extended to aliphatic amines. With methylamine the product obtained as indicated by its analysis and reactions is most probably the methyl dithiobiuret; $\text{MeNH.CS.NH.CS.NH}_2$. This last undergoes a series of changes as have been observed with phenyl- and other aryl dithiobiurets. For instance, when treated with iodine it gave a yellow hydriodide presumably of the corresponding thiuret which when treated with ammonia precipitated sulphur and formed methylformamido thiourea m.p. 154-55°C. This, like the methylformamido thiourea obtained by the condensation of methylisothiocyanate and guanidine carbonate, takes up iodine and forms an oxidation product which is under examination.

188. Synthesis of compounds analogous to Entamide.

A. B. SEN and O. P. MADAN, Lucknow.

Compounds analogous to Entamide (2,2-dichloro-4'-hydroxy-N-methyl acetanilide) a new amoebicide introduced by Boots Pure Drug Co., Ltd., England, which is reported to possess high amoebicidal activity (Bristow *et al.* Trans. Roy. Soc. Trop. Med. Hyg., 1956, 50, 182) have been synthesised. This work reports the synthesis of eight alkylamino compounds viz., 2-chloro-4-N-alkylamino phenols, 2-chloro-4-N-alkylamino anisoles and 5-iodo-2-N-alkylamino toluenes. The dichloro acetanilides of these compounds and of 2-chloro-4-amino phenol, 2-chloro-4-amino anisole and 5-iodo-2-amino toluene were also prepared with a view to test them as antiamoebic agents.

189. Synthesis of some Nitrophenothiazines.

A. B. SEN and A. K. ROY, Lucknow.

Several nitrophenothiazines have been prepared with a view to study their antibacterial activity.

The nitrophenothiazines were prepared by the Smiles rearrangement of the corresponding diphenylsulphides with sodium hydroxide.

The required diphenyl-sulphides were obtained from 2,4-dinitro chlorobenzene, 1-chloro-4,6-dinitro-3-ethyl benzene and ethyl 2-chloro-3,5 dinitro benzoate by condensing with the sodium salt of 2-amino-5-chloro thiophenol, 2-amino-5-methyl thiophenol, 2-amino-5-chloro-3-methyl thiophenol and 2-amino-5-bromo thiophenol in absolute alcohol.

The thiophenols were prepared according to the method of Farrington and Warburton (Australian J. Chem., 1955, 8, 545).

190. Possible Antiamoebic Agents, Part X. Compounds based on the partial structure of Aureomycin.

A. B. SEN, S. L. ARORA and Y. D. KULKARNI, Lucknow.

5-substituted-3-aceto-2,2'-dihydroxy benzophenones, resembling the partial structure of Aureomycin, have been synthesised with a view to testing their antiamoebic activity.

Attempts to prepare these benzophenones by the Fries migration of (a) Phenolic esters of Salicylic acid or (b) phenolic esters of Aspirin were unsatisfactory. Further the fusion of xanthone ring with KOH also did not yield the required compound. The desired dihydroxy benzophenones were prepared successfully and in good yields by the Fries migration of the esters which in turn were obtained by refluxing the benzene solution of 5-substituted (viz., chloro, methyl and tert.-butyl)-2-hydroxy-acetophenones and 2-methoxy-benzoyl chloride in the presence of magnesium ribbon. The ketones were characterized through their 2:4-dinitrophenyl-hydrazones.

191. Isoquinolines as Potential Antispasmodics.

A. RAYCHAUDHURI, Calcutta.

3-Carbox-piperidino-isoquinoline has been prepared by reacting ethyl isoquinoline-3-carboxylate with piperidine. On reduction with lithium aluminium hydride it is expected to afford 3-piperidino-methyl-isoquinoline.

3-Benzyl isoquinoline (I) was prepared for antispasmodic screening to observe the effect of a benzyl group at the 3-position of the isoquinoline nucleus instead of a substituted benzyl group at 1-position as found in Papaverine. (I) was claimed to have been synthesized together with isomeric 4-benzyl-isoquinoline by Rügheimer by reacting benzaldehyde with benzoyl tetrahydroisoquinoline. But the physical characteristics of 3-benzyl-isoquinoline, synthesized in this laboratory by an unambiguous method, are at variance with those of Rügheimer. (I) has now been synthesized by subjecting the formamido compound, obtained from the Leuckart reaction of dibenzyl ketone, to Bischler-Napieralski cyclisation and subsequent dehydrogenation of 3-benzyl dihydro isoquinoline. Dibenzyl ketone required for the synthesis was obtained by hydrolysis of α -phenylacetyl benzyl cyanide, prepared by reacting ethyl phenylacetate with benzyl cyanide in presence of sodium ethoxide.

3-Benzyl isoquinoline was brominated at the 3-position and reacted with piperidine to afford 3-(α -1'piperidy)-benzyl isoquinoline (II) which can be regarded as a basically substituted 3-methyl isoquinoline. (II) has been characterised as picrate and phosphate.

192. Isoquinoline Derivatives, Part VI

T. N. GHOSH, Calcutta.

Ethyl α -acetamido- α -ethyl (or propyl)- β -phenylpropionate (I), when subjected to Bischler-Napieralski cyclisation with phosphorus pentoxide in an inert solvent, has furnished the fully aromatised isoquinoline derivative, namely, 1-methyl-3-ethyl (or propyl) isoquinoline (II). The structure (II) has been established by an independent synthesis: Benzyl ethyl (or propyl) ketone, when subjected to Leuckart procedure, has yielded 1-phenyl-2-formamido-butane (or pentane) (III). Hydrolysis of (III) has given 1-phenyl-2-amino-butane (or pentane), the N-acetyl derivative of which, when treated with phosphorus oxychloride, yields 1-methyl-3-ethyl (or propyl)-3:4-dihydro-isoquinoline (IV). Dehydrogenation of (IV) over Pd-C in tetralin has furnished (II). It is significant to record that during the similar conversion of the α -methyl analogue

of (I), namely, ethyl α -acetamido- α -methyl- β -phenylpropionate to 1:3-dimethyl-isoquinoline carbon monoxide is now found to be eliminated, as identified by a solution of sodium palladous chloride containing sodium acetate and confirmed by ammoniacal cuprous chloride adsorption. This gives an insight into the mechanism of the above reaction, which evidently involves cyclodehydration and elimination of carbon monoxide and consequently, of ethanol.

193. Search for New Antispasmodics, Part IX.

T. N. GHOSH and A. RAYCHAUDHURI, Calcutta.

1-Phenyl-1-(*p*-methoxy) benzylidene-propan-2-one (I), obtained by condensation of benzyl methyl ketone with anisaldehyde in presence of hydrochloric acid, has been condensed with paraformaldehyde and piperidine to furnish 1-phenyl-1-(*p*-methoxy) benzylidene-4-piperidino-butan-2-one (II). On catalytic hydrogenation, (II) has given 1-phenyl-1-(*p*-methoxy) benzyl-4-piperidino-butan-2-one (III). It is significant to observe that 1-phenyl-1-(*p*-methoxy) benzyl-propan-2-one (IV), obtained from (I) by catalytic hydrogenation, has given the same base (III) when reacted with paraformaldehyde and piperidine, showing that in such ketones the methyl group is more reactive than the methynyl, for Mannich reaction.

194. Synthesis of Biguanides as potential Hypoglycemic Agents, Part II.

U. P. BASU and T. N. GHOSH, Calcutta.

In a previous communication the synthesis of a number of mono-substituted biguanides, including N^1 -phenylethylbiguanide (known as DBI) has been recorded. In the meantime much useful information on the hypoglycemic action of DBI has been available. Although the clinical reports are encouraging and the drug has been found to be useful in mild diabetic patients, it has certain annoying side-effects which are restricted to gastrointestinal tract. In view of these observations, chemical modification of DBI is considered necessary and hence the synthesis of mono-substituted biguanides has been continued. N^1 -dibenzylmethylbiguanide, N^1 (α -methyl- β -phenyl) ethylbiguanide, N^1 (α -ethyl- β -phenyl) ethylbiguanide and N^1 (α -propyl- β -phenyl) ethylbiguanide have now been synthesised in the form of hydrochloride by reacting dicyandiamide with the respective amine at an elevated temperature. 1-Phenyl-2-amino-butane and 1-phenyl-2-aminopentane, required for the preparation of the last two biguanides, have been conveniently prepared by subjecting benzyl ethyl ketone and benzyl propyl ketone respectively to Leuckart procedure.

195. Investigations on *Stephania hernandifolia* Walp. Part I.

B. K. MOZA Calcutta.

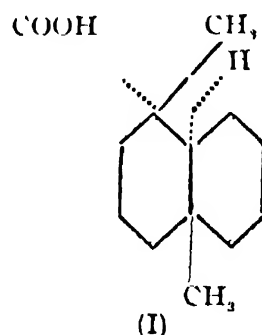
No systematic investigations seem to be on record regarding the constituents of *Stephania hernandifolia* Walp. In this connection, some preliminary observations, that constitute the present work, reveal that it contains alkaloids, steroids and fats as the main constituents. The alkaloidal content appears to be maximum in the roots (2.72%) followed very closely by that of the rhizomes (2.5%) and least in the leaves (0.06%). For the identification of various alkaloids present in this plant, paper chromatographic and paper electrophoretic methods have been developed. The Whatman No. 1 paper is first soaked with the lower phase of, McIlvaine sodium phosphate-citric acid buffer pH 2.2 and butanol solvent system, dried and then the chromatogram is developed on it with the upper phase of above solvent system,

The spots of alkaloids are identified under ultraviolet light and by spraying the paper chromatogram with the modified draggendorf reagent. Four main alkaloids and two trace alkaloids have been thus identified in the roots and rhizomes of the above plant. A satisfactory separation of the four main alkaloids of roots and rhizomes by paper electrophoresis using Mellvaine phosphate-citric acid buffer pH 2.2 at 210 volts for six hours, is also described. It is of interest to note that the leaves of the plant contain mainly only one alkaloid and differ in this respect from its roots and rhizomes.

196. Synthetic Studies in Resin Acids.

N. K. BASU and A. K. DAS GUPTA, Calcutta.

An approach is being made for the stereospecific synthesis of the bicyclic acid (I, Ghatak, Saha and Dutta, J. Amer. Chem. Soc., 79, 4487, 1957).



Ethyl bromoacetate was condensed with 1, 10-dimethyl-2-keto- $\Delta^{1,9}$ -octalin in presence of pot. *tert.* amylate in benzene (Stork and Schulenberg, J. Amer. Chem. Soc., 78, 250, 1956) to yield ethyl, 1, 10-dimethyl-2-keto- Δ^8 -octalin-1-acetate (b.p. 135-142°/0.6 mm.). The keto-ester was condensed with ethylene dithiol in presence of anhydrous zinc chloride and the crude condensation product on alkaline hydrolysis yielded the solid thioketal acid (m.p. 214°); methyl ester (m.p. 100°, diazomethane method). The methyl thioketal-ester was desulphurised by boiling with Raney nickel in ethanol to yield methyl 1, 10-dimethyl- Δ^8 -octalin-1-acetate (b.p. 114°/5 mm.), which on catalytic hydrogenation with 10% Pd-C in acetic acid solution yielded methyl 1, 10-dimethyl-1-acetate (b.p. 136°/6 mm.). The stereochemistry at the ring junction of the saturated ester should be *trans* as it is obtained through the reduction of the hindred ring-junction double bond (Stork *et al.*, loc. cit.; Ghatak, Ray and Datta, J. Amer. Chem. Soc., in Press). The above ester was condensed with excess of phenylmagnesium bromide and the crude carbinolhydrocarbon mixture was subjected to oxidation with chromic acid in acetic acid to yield the acid (I) as a glassy solid. Experiments for the isolation of crystalline bicyclic acid (I) through chromatograph over silica gel are being continued.

197. Synthetic Studies in Terpenoids.

SOURMYENDRALAL MUKHERJEE, Calcutta.

In the course of the total synthesis of bicyclic-diterpenoids, the preparation of 1:1-dimethyl- $\Delta^{5,10}$ -octalin-6-one (I) was described (Mukherjee and Dutta, Proc. Ind. Sci. Cong., Part III, p. 130, 1958). Present communication describes further studies with the octalone (I) to introduce functional groups at the required positions.

Conjugate addition of cadmium dialkyl also failed under all experimental conditions so far tried. Attempts were next made to introduce the angular methyl

group through conjugate potassium cyanide addition, hydrolysis and reduction of the corresponding ester to methyl. The unsaturated ketone (I) was allowed to react with potassium cyanide and a series of products were isolated. Neutral fractions afforded a keto-amide, m.p. 169-170° and hydroxy-lactam, m.p. 264-265° which were also evident from infra-red showing corresponding strong bands. The acidic fractions, on esterification, gave the desired keto-ester, 1:1-dimethyl-10-carbomethoxy-decal-6-one (b.p. 123-125°/0.5 mm.) in a very poor yield. To build up the aliphatic C₆-chain present in the resin acids mentioned earlier (Mukherjee and Dutta, loc. cit.), ethyl δ -bromo- β -methyl valerate b.p. 78-80°/5 mm.) was condensed with the octalone (I) whereupon 1:1-dimethyl-5-(γ -ethoxy-carbonyl- β -methyl butyl)- Δ^5 ,¹⁰-octalin-6-one (b.p. 172-173°/0.4 mm.) was obtained.

198. Synthesis of ethyl 2,6-dimethylnonae-1,9-dicarboxylate.

J. R. MAHAJAN, Calcutta.

To build up a ten-membered ring carrying β -keto-ester system, ethyl 2,6-dimethylnonae-1, 9-dicarboxylate (I) was prepared according to the following scheme. However, it failed to give the desired product on ring-closure by high-dilution technique.

The condensation product from δ -acetylvalerate and ethyl cyanoacetate was reduced (Pd-C), hydrolysed and subsequently esterified to afford ethyl β -methyl-suberate in an excellent yield. This on ring-closure under high-dilution technique and methylation of the product in situ gave 3,7-dimethyl-7-carbethoxycycloheptanone. Hydrolysis afforded 3,7-dimethylcycloheptanone; semicarbazone, m.p. 194°. Ring-fission with ethylnitrite and subsequent hydrolysis of the oximino derivative gave ethyl ω -acetyl- β -methylcaproate. Reformatsky's reaction with ethyl γ -bromocrotonate and subsequent dehydration and hydrogenation gave (I).

199. Studies in the cycloheptane series, Part II. The synthesis of benzcyclohexanespirocycloheptane and 7-methylbenzcyclohexanespirocycloheptane.

G. S. SAHARIA, Delhi.

Earlier interest in the Chemistry of benzcycloalkanes and benzcyclohexane in particular arose out of their relationship to naphthalene and phenanthrene and the developments associated with the Baeyer's Strain Theory. Benzcycloheptane derivatives constitute important starting materials for the study of benzotropolones and azulenes.

In the present investigation of the syntheses of benzcyclohexanespirocycloheptane and 7-methylbenzcyclohexane spirocycloheptane experiments have been carried out with a view to study the effect of the cycloheptane ring in the formation of the cyclohexane ring and also compare the effects of the five, six and seven membered rings in the formation of the cycloheptane ring.

Ethyl cycloheptylidene cyanoacetate, prepared from cycloheptanone and ethylcyanoacetate, was treated with potassium cyanide and the resulting dicyanoester on hydrolysis gave 1-carboxy cyclopentane-1-acetic acid. Its anhydride was condensed with benzene and toluene under the conditions of the Friedel-Crafts reaction to give the corresponding Keto acids; these were reduced by the Wolff-Kishner method and these reduced acids were then cyclised to give the respective spiroketones. Finally, these Ketones on Clemmensen reduction furnished the two spirohydrocarbons.

200. Enol content of the Substituted Amides of Aceto-acetic Acid.

B. N. MANKAD and M. R. PATEL, Vidyanagar.

Enol content of the substituted amides of aceto-acetic acid viz.: anilide, (o-,m-,p-,) toluidides, (o-,m-,p-,) chloroanilides (o-,m-,p-,) bromoanilides, has been determined in ethanolic solution at different concentrations. It is revealed that (i) enol content increases with dilutions; (ii) -CONHR group in place of -COOR group increases the enol content. Electronic interpretation for enolisation is given.

201. A study on the Meerwein's Diazo Reaction with Furan-2-Carboxylic Acid (Furoic Acid).

K. B. L. MATIUR and H. S. MEHRA, Delhi.

Aryl diazonium chlorides have been reacted with Furan 2-carboxylic acid (I) under Meerwein's conditions, but omitting the use of acetone. Coupling occurs mostly in the 5-position (I) and minutely in the 2-position (II) to give respectively 5-aryl furan 2-carboxylic acid and traces only of 2-aryl furans (III). However a certain amount of decarboxylation (ca. 6-7 per cent) also occurs in which the furan nucleus of (I) is not arylated.

The following 5-aryl furan 2-carboxylic acids (II) were prepared by the coupling reaction: p-chlorophenyl-, m.p. 193-4°; p-bromophenyl-, m.p. 198-9°; p-nitrophenyl-, m.p. 246-7°; m-nitrophenyl-, m.p. 244°. The p-chloro-, and m-nitrophenyl acids were characterised by their oxidation with bromine water (cf. Hill et. al., Ber, 1890, 23, 452) to the respective β -aryl acrylic acids identical with authentic samples. In the coupling, reactions, the furan ring displays a 'super aromatic' character rather than make the acid (I) behave like a dienic acid.

202. Chemical Investigation of Coriandrum Sativum Linn Seeds.

M. O. FAROOQ, I. P. VARSHNEY and M. Z. NAIM, Aligarh.

The seeds of Coriandrum sativum Linn have been found to contain d-mannitol m.p. 166°, acetate m.p. 119-20° (Lit. d-mannitol m.p. 166° and acetate m.p. 119-120°). These have been identified by melting and mixed melting points with authentic samples and a paper chromatographic comparison. The seeds show the presence of flavanoid glycosides also. These, so far, have not been isolated in a pure form. The presence of reported triterpenoid could not be confirmed.

203. Synthesis of Polyphenylated Dicarboxylic Acids, Dibenzhydryl Succinic Acid.

M. O. FAROOQ, W. RAHMAN and Miss. S. J. BEGUM, Aligarh.

Dibenzhydryl succinic acid has been synthesised by two methods. (i) The first procedure involves the condensation of diphenylbromomethane with mono-sodio-malonic ester which gives ethyl diphenylisobutyrate. This ester on treatment with iodine and molecular sodium gives a tetracarboxylic ester. This ester on hydrolysis followed by decarboxylation yielded a dicarboxylic acid m.p. 142-43. The acid is characterised as dibenzhydryl succinic acid by analysis and neutralization equivalent. (2) The second method consists of (a) the preparation of $\beta\beta$ -diphenyl α -bromopropionic acid by Hell-Volhard-Zelinsky reaction, (b) esterification of the acid to give $\beta\beta$ -diphenyl- α -bromo ethyl propionate, (c) condensation of the α -bromoester in presence of molecular sodium (Wurtz's reaction) and (d) hydrolysis of the ester to give benzhydryl succinic acid.

204. Studies on Indigenous Tanning Materials, I—Isolation of Sucrose from Babul Bark—Acacia Arabica Willd.

J. B. RAO, K. N. S. SASTRY and Y. NAYUDAMMA, Madras.

Tannin bearing plants occur in temperate tropical and subtropical countries and India is rich in such plants. One such commercially important is Babul, *Acacia Arabica* Willd, the bark of which is extensively used in Leather Industry. In the course of systematic and detailed investigations on the plant, we have been able to isolate Sucrose, in its crystalline form from the Inner bark while it is totally absent in the outer regions of bark.

Freshly cut Babul bark was separated easily into the fissured inner bark and outer bark, and immediately taken up in distilled water separately. Extracts from the two different regions of the bark were obtained. They were purified through Alcohols. The purified extracts were dissolved in known quantities of methyl alcohol and allowed to stand for sometime, when crystals of pure Sucrose got separated from methanolic solution of Purified extract from Inner bark, while no separation of Sucrose or any other substance occurred in the methanolic solution of purified extract from outer bark. This experimental observation has probably a bearing on the biosynthesis of tannins in Babul Plant.

205. Tetracyclines, Part I : Synthesis of 7:10-Dimethoxy-5:6:11:12-Tetrahydronaphthacene-6:12-dione.

A. L. PANDIT and A. B. KULKARNI, Bombay.

With a view to develop a method for the synthesis of hydronaphthacenes, 2-(2-carboxybenzylidene)-5 : 8-dimethoxy-1-tetralone was synthesised by condensation of o-phthalaldehydic acid with 5 : 8-dimethoxy-1-tetralone. Cyclisation of the former to 7 : 10-dimethoxy-5 : 6-11 : 12-tetrahydronaphthacene-6 : 12-dione was achieved using polyphosphoric acid as a cyclising agent. Further the structure of the lactone, which was obtained as an intermediate with acidic reagent on 2-(2-carboxybenzylidene)-5 : 8-dimethoxy-1-tetralone was arrived at by reducing the former with lithium aluminium hydride and studying the reduced products and its derivatives by chemical and physical methods. 2-(2-Carboxybenzylidene)-5-methoxy-8-methyl-1-tetralone was synthesised, however, it could not be cyclised to the corresponding hydronaphthacene.

206. Tetracyclines, Part II—3-Carboxy-1-tetralones as intermediates for the synthesis of hydronaphthacene.

A. L. PANDIT, S. SHESHADRI and A. B. KULKARNI, Bombay.

In the previous paper the synthesis of a tetrahydronaphthacene dione using a tetralone as an intermediate was described. The low yield of the hydronaphthacene in the last step i.e. the cyclisation of the o-carboxybenzylidene tetralone as well as the difficulty of preparing suitably substituted o-phthalaldehydic acid prompted us to search for other routes which would lead to the desired compounds in better overall yield from more easily accessible materials. In this paper 7-methoxy-3-carboxy-1-tetralone is condensed with anisaldehyde and the resulting benzylidene tetralone carboxylic acid is hydrogenated to the dihydro derivative and the latter is smoothly cyclised to the corresponding hydronaphthacene. The general applicability of this method using different tetralones and aldehydes has been studied. The constitution of the intermediates is established by chemical and physical methods.

207. Tetracyclines, Part III—Synthesis of substituted hydronaphthacenes.

S. SESHADRI and A. B. KULKARNI, Bombay.

This paper describes synthesis of substituted hydronaphthacenes having substituents similar to those in the tetracyclines. No benzylidene could be obtained by the condensation of 7-methoxy-3-carboxy-1-tetralone with 3:5-dimethoxy benzaldehyde while 3:4:5-trimethoxy benzaldehyde condensed with the same tetralone giving the corresponding benzylidene derivative in low yield. Similarly 2:4-dimethoxybenzaldehyde condensed readily with 7-methoxy-3-carboxy-1-tetralone. The benzylidene derivative so obtained was carefully hydrogenated and cyclised to 2:4:8-trimethoxy-5:5a:6:11:11a:12-hexahydronaphthacene-6:12-dione. Attempts to prepare hydronaphthacenes containing an amino group by condensation of nitro aldehydes with 3-carboxy tetralones and the reduction of the nitro group in the resulting benzylidene and its cyclisation were unsuccessful. So also synthesis of amino-3-carboxy tetralones through the condensation of nitro aldehyde with ethyl succinate, the reduction of the Stobbe condensation product, nitro to the amino-group and its cyclisation were fruitless.

208. Synthesis of 2'-hydroxy-5'-nitro Nitroflavones. Part I : Preparation of 8-nitroflavones.

MARATHHEY M. G. (Amravati) and NAIK V. G. (Poona).

Nitro flavones have been prepared from 2-hydroxy-3-nitro-5-methyl acetophenone by condensation with (a) benzaldehyde (b) anisaldehyde (c) piperonal (d) vanillin benzyl ether (e) veratraldehyde (f) salicylaldehyde (g) m-hydroxy benzaldehyde (h) p-hydroxy benzaldehyde and (i) vanillin, when the corresponding chalcones were obtained. In cases of aldehydes a, b, c, d, e i both cis and the trans isomers of the chalcones which gave the same acetyl derivative could be obtained and the cis isomers could be converted into the trans by boiling with glacial AcOH. Chalkone was also prepared from (j) m-nitro benzaldehyde.

The chalcones were converted into the flavonols by using alkaline hydrogen peroxide. Chalkones from 'a' and 'b' were converted into the acetoxy dibromides to give the corresponding flavones and the benzal coumaranone in case of 'b'. The flavones were also obtained from the chalcones of 'a' and 'b' by using selenium dioxide.

209. Synthesis of 2'-hydroxy-5'-nitro-3':4'-benzochalkones.

M. G. MARATHEY and B. J. GHIYA, Amaravati.

2'-Hydroxy-5'-nitro-3':4'-benzochalkones were prepared by condensing 2-hydroxy-3:4-benzo-5-nitro acetophenone with (a) BzH (b) anisaldehyde (c) salicylaldehyde (d) m-OH BzH and (e) p-OH BzH in the presence of 10N NaOH when the time required to effect the condensation was more than three hours. With Na₂O₂ chalkones were obtained within five minutes. In cases of hydroxy aldehydes the m-OH gave maximum yield, p-OH though giving more than the o-OH, gave much less than the m-OH.

The chalkones were converted into the flavonols by using Na₂O₂ and into the flavones through the dibromides.

The effect of the nucleophilic group -NO₂ in the ketone was found to facilitate the condensation.

210. Search for New Antimalarials : Part III—Synthesis of Some Substituted Quinazolines.

A. B. SEN and P. R. SINGH, Lucknow.

Twenty-four mono- and di-halogen substituted, 4-alkyl and 4-dialkyl amino-quinazolines have been synthesised as possible antimalarials.

5-Chloro-, 5-bromo-, 5-iodo-, 3 : 5-dichloro-, 3 : 5-dibromo-, 3 : 5-diiodo-, 3-bromo-5-chloro-, 3-iodo-5-chloro-, 3-chloro-5-bromo-, 3-iodo-5-bromo-, 3-chloro-5-iodo- and 3-bromo-5-iodo- anthranilic acids have been prepared, the latter six for the first time, by the stepwise halogenation of anthranilic acid. These acids condensed with formamide to yield the corresponding 4-hydroxy-quinazolines as described by Endicott *et al* (*J. Amer. Chem. Soc.*, 1946, 68, 1299, 1303), which on heating with PCl_5 and POCl_3 (Norman *et al*, *J. Chem. Soc.*, 1947, 891, Endicott *et al.*, *loc. cit.*) were converted to 4-chloro-quinazolines. Chloroquinazolines condensed with ethanolamine and diethanolamine to give 4- β -hydroxyethylamino- or 4-di-(β -hydroxyethyl)-amino-quinazoline hydrochlorides, which were characterised through their picrates and have been sent to the Malaria Institute of India for the evaluation of their anti-malarial activities.

211. Search for New Antimalarial : Part IV—Synthesis of Some N¹-(6-halogeno-4-quinazolyl)- and N¹-(6:8-dihalogeno-4-quinazolyl)-N¹-Substituted Phenyl Biguanides.

A. B. SEN and P. R. SINGH, Lucknow.

Sixteen N¹-(6-halogeno-4-quinazolyl)- and N¹-(6 : 8-dihalogeno-4-quinazolyl)-N¹-substituted phenyl biguanide hydrochlorides have been prepared as possible antimalarials. They were obtained by the condensation of 6-chloro-, 6-bromo-, 6-iodo-, 6 : 8-dichloro-, 6 : 8-dibromo-, 6 : 8-diiodo-, 6-chloro-8-bromo-, 6-chloro-8-iodo-, 6-bromo-8-chloro-, 6-bromo-8-iodo-, 6-iodo-8-chloro- and 6-iodo-8-bromo-4-chloro-quinazolines described in Part-III, with p-chlorophenyl-, p-anisyl- or p-phenetyl biguanides, with the expectation that the biguanido grouping may promote a prototropic change and/or tend to form a chelate ring with some metallic ion, trace of which might be essential for the metabolism of the malarial parasite. (Curd *et al.*, *Nature*, 1946, 158, 707; Basu *et al.*, *Science & Culture*, 1947, 13, 205). These quinazolyl-biguanides were characterised through their picrates and their antimalarial activities are under investigation at the Malaria Institute of India, Delhi.

212. Hydroxy Ketones, Part XI. The synthesis of possible antileprosy compounds.

G. S. SAHARIA, Delhi.

A variety of fatty acids have been prepared and tested for antileprosy effect. It was found that amongst other things, a disubstituted acetic acid with a molecular weight between 250 and 280 had the most desirable physiological properties; this effect is even more marked if a cyclohexyl group is present in one of the alkyl groups. The present work deals with the synthesis of some hydroxy ketones of the molecular formula $\text{C}_8\text{H}_{11}\text{OR}$ having M.W. between 250 and 280 and at least one cyclohexyl and a phenyl group. The presence of the carboxyl group in the compound would render it lipid soluble which could be used as injectable. For this purpose, a preliminary study of the Pries migration of the phenolic esters of cyclohexane carboxylic acid was made, as this would enable us to establish the experi-

mental conditions for the preparation of the compounds described above. The migration of the esters was carried out at 120° and 160°; the ortho and para-hydroxy ketones were separated by their solubility difference in aqueous sodium carbonate. The yields of the hydroxy ketones were poor in all cases and considerable quantities of the unchanged ester were recorded unreacted.

213. Studies on the Polymerisation of vinyl acetate in different solvents.

S. NIGAM and M. S. MUTHANA, Kharagpur.

Kinetics of the solution polymerisation of vinyl acetate in benzene, toluene, ethyl benzene have been reported in this paper. In all the systems the rates of polymerisations are found to be very low compared with bulk polymerisation than can be attributed to dilution of the monomer. The reactions with respect to monomer concentration are found not to be of first order.

It has also been observed that the rate of polymerisation is higher in azo initiator than benzoyl peroxide in all cases, but intrinsic viscosities remain nearly the same in both the cases.

214. Studies on the bulk polymerisation of n-butyl methacrylate and iso-butyl-methacrylate.

A. S. NAIR and M. S. MUTHANA, Kharagpur.

In continuation of the work already reported polymerisation reactions of n-butyl methacrylate have been completed with benzoyl peroxide and 2, 2'-azo-bis-isobutyronitrile as initiators. The overall rate of polymerisation follows the square root law with respect to initiator concentration and the rate constant has been found to remain reasonably constant for varying concentration of initiators.

215. Studies on the copolymerisation of n-butyl methacrylate and iso-butyl methacrylate with vinyl acetate and acrylonitrile.

A. S. NAIR and M. S. MUTHANA, Kharagpur.

Copolymerisation studies have been carried out using different concentrations of the monomers in presence of benzoyl peroxide initiator. The values of the reactivity ratios have been computed by the graphical method and have been discussed in the paper.

216. Studies on the solution of polymerisation of n-butyl methacrylate and iso-butyl methacrylate.

A. S. NAIR and M. S. MUTHANA, Kharagpur.

With a view to investigate the behaviour of n-butyl methacrylate and iso-butyl methacrylate in solution polymerisation and also to determine the chain transfer constants, polymerisation reactions of these esters have been carried out in benzene solution using benzoyl peroxide as initiator. The overall rate of polymerisation shows that the order of the reaction is 1.5 with respect to the monomer concentration indicating an initiation process dependent on monomer concentration.

217. Study of the component amino acids of the proteins from the fish *Labeo rohita*.

R. D. TIWARI and K. C. SRIVASTAVA, Allahabad.

Component amino acids of the muscle, blood and scale proteins from the fish *Labeo rohita* at different stages of its growth have been studied with a view to study the variation of amino acids in different parts of the fish at different stages of its growth.

The proteins at different stages were isolated from the material by the usual methods and each of these were hydrolysed separately with 6 N HCl. The component amino acids were identified by paper chromatography.

In muscle protein Tyrosine, Aspartic acid, Ornithine, Isoleucine & Citraulline are present in all stages of growth, while Serine, Arginine, Alanine are only present in the earlier stages; Nor-Leucine, Methionine, Leucine and Hydroxy Proline appear in the later stages of growth.

In blood protein Glycine, Tyrosine, Isoleucine, Proline Glutamic acid and Methionine, are present in all the stages while Ornithine, Serine, are present only in the earlier stages, Alanine, Nor-Leucine, Cystine & Lysine appear in the later stages of growth.

In scale protein Aspartic Acid, Nor-Leucine, Proline, Methionine are present in all stages of growth, while Ornithine, Isoleucine, Glutamic Acid and Hydroxy Proline are present only in the earlier stages. Cystine, Glycine, Tyrosine, Alanine, Isoleucine, Valine appear in the later stages of growth.

218. Mannitol from the bark of *Clerodendrum indicum*.

R. D. TIWARI and S. P. GARG, Allahabad.

The hot alcoholic extract of the bark of *Clerodendrum indicum* when allowed to stand, deposited a white product which after crystallisation from ethanol was found to melt at 164°C. It was found to be an aliphatic hexahydric alcohol and after characterisation it was found to be identical with mannitol. Other constituents of the bark are under examination.

219. Preparation of nitro-hydroxy and carbmethoxy hydroxy chalkones and their cyclization to corresponding flavanones.

P. L. TRIVEDI, Rajkot.

Some chalkones from methyl-2 : 4-dihydroxy-5-acetyl-benzoate and 2-hydroxy-3-nitro-5-methylacetophenone have been prepared by condensing them with various aromatic aldehydes in presence of caustic potash. The cyclization of the chalkones from the first ketone has been carried out by esterification and subsequent boiling with aqueous alcoholic sulphuric acid. Some chalkones from the second ketone did not cyclize at all, while some of them could be easily converted to their isomeric flavanones under the above conditions. These results of cyclization show that nitro and carb-methoxy groups in 3 and 5 positions respectively have very little influence on flavanone conversion, while nature and position of the substituent in the aldehydic part (Phenyl group) in the case of chalkones from the second ketone have a great influence on the cyclization. The properties of the chalkones and flavanones have also been studied.

220. Chemical study of the Active Principles of the Flowers of Rakta Karavi (*Nerium Odorum Soland*).

P. K. SANYAL, and N. DUTTAGUPTA, Calcutta.

It has been observed in earlier experiments that the Flowers of Rakta Karavi (*Nerium Odorum Soland*), contain some cardiac glucosides and in order to isolate the active principles this work has been carried out.

Flowers of Rakta Karavi, (Collected from Rajbahan, Calcutta) were dried, defatted and extracted with 80 per cent alcohol under percolation process. The alcoholic extract was evaporated under reduced pressure and the residue was dissolved in hot water and treated with precipitated lead hydroxide—filtered and the filtrate evaporated under reduced pressure.

The substance obtained was extremely bitter in taste and when tested confirmed the presence of glycosides.

Experiments were carried out to crystallise the active principles and to isolate the genins. The crystallisation of the glycosides could not be done by methyl alcohol, ethyl acetate, n butyl alcohol and several other solvents, though it was observed that the substances were highly soluble in methyl alcohol. Adsorption on charcoal revealed that the bitter principles were completely adsorbed. Elution of the dried charcoal with methyl alcohol failed to bring out any bitter principles, neither any residue was obtained on evaporation of methyl alcohol. Although ethyl acetate was successful in extracting the bitter principles, crystallisation was not possible due to the minute amount of solids obtained.

The usual procedure of genin isolation after hydrolysis of the glycoside with ethyl alcohol and hydrochloric acid revealed the presence of a white crystalline genin and a yellow coloured flavone derivative.

Paper chromatography with the sugar part showed only glucose to be present.

The petroleum ether (40°. 60°) extractive showed in its unsaponifiable part the presence of steroids and higher fatty alcohols. The acetates of a steroid and a higher fatty alcohol have been isolated by column chromatography on Brockman alumina.

221. Possible Anti-tuberculous Compounds, Part III—Preparation of Diphenyl Amine-4-aryl or Alkyl Amidines.

VINAY S. MISRA and MD. IMTIAZ HUSAIN, Lucknow.

Several Diphenyl amine N-4-Aryl or Alkyl amidines have been prepared with a view to increase the basicity and surface area of N-4-Diphenyl amidines, compounds of known anti-tubercular activity.

4-amino diphenylamine was first converted into 4-Diphenylamine ammonium benzene sulphonate. The latter on heating with different aromatic and aliphatic nitriles at 230—35°C, yielded appropriate amidine benzene sulphonates, which liberated the respective free amidines by the usual process of basification and isolation as adopted by Oxley and Short (J. Chem. Soc., 1946, p. 147).

222. Possible Anti-tuberculous Compounds, Part I—Preparation of α -tetrahydro naphthyl Amidines.

VINAY S. MISRA and MD. IMTIAZ HUSAIN, Lucknow.

In order to establish the relationship between structure and activity of anti-tuberculous compounds and also with a view to increase the lipid solubility and surface area of α -Naphthyl-amine and N-1-Naphthyl benzamidine, compounds of known anti-tubercular activity, five new α -tetrahydro naphthyl amidines have been prepared,

The α -tetrahydro Naphthylamine, prepared by the method described by Bamberger et al (Berichte, 21, p. 1789), was converted into α -tetrahydro-Naphthyl ammonium benzene sulphonate by adopting the method of Bauer & Cymerman (J.C.S., 1950, 1826). The latter was then converted into five different amidine benzene sulphonates and consequently to corresponding amidines.

223. Possible Anti-tuberculous Compounds, Part II—Preparation of β -tetra-hydro-naphthyl Amidines.

VINAY S. MISRA and MD. IMTIAZ HUSAIN, Lucknow.

With a view to increasing the surface area and lipid solubility of β -tetrahydro Naphthyl amine, one of the strongest organic bases, as mentioned by Bamberger and Muller (Chem. Abstract, 1888, p. 599), several new β -tetrahydro-Naphthyl amidines have been prepared.

In the present communication, we have tried to increase the surface of N-2-Naphthyl amidines, compounds of known anti-tubercular activity as referred to in the literature by Oxley and Peak (J. Chem. Soc. 1951, p. 485) by reduction of β -Naphthylamine to β -tetrahydro Naphthylamine and subsequently preparing several new amidines with partly saturated and partly unsaturated nucleus by usual method of Oxley and Short (J. Chem. Soc., 1946, p. 147).

224. Attempts at processing Indian gooseberry for ascorbic acid.

J. C. DEB, N. CHANDRASEKHARA and M. SRINIVASAN, Mysore.

Attempts have been made to prepare a rich concentrate of ascorbic acid from the Indian gooseberry (*Phyllanthus emblica*) Linn, a reputed source of vitamin 'C'. Among the new properties now found is that the juice with a total soluble solids content of 10% has a specific rotation of $[\alpha]_D^{25} = -18.3^\circ$. Ten times concentration of the juice over a free flame caused less than one per cent loss of ascorbic acid and a loss of 10% even when so concentrated twenty times. Neutralisation before concentration caused greater losses. Among the various methods tried to remove the associated impurities, surprisingly enough lead acetate was found to be the most efficient. These results will be discussed.

225. The attack of a carbon-halogen bond by carbene.

N. K. CHAUDHURI, Bombay.

A number of reports in recent years shows that carbenes formed by the photolysis of aliphatic diazo compounds can attack a carbon-hydrogen bond, inserting itself between the atoms. There is still no evidence for the insertion of a carbene into a saturated carbon-carbon bond. In this report evidence is produced to show that a carbene formed by the photolysis of diazo-methane can attack a carbon-halogen bond. When diazo-methane was photolysed in chlorobenzene solution benzyl chloride was found to be one of the products along with chlorotropolidene and isomeric chlorotoluenes. A similar result was obtained with bromo-benzene.

226. Mercurated Dyes, Part II—The preparation of some Mercurated Azo Dyes.

(Miss) K. SRIVASTAVA and A. N. DEY, Kanpur.

In a previous paper we have described the preparation of some mercurated azoic dyes. The present investigation deals with similar preparation of the mercurated derivatives of some azo dyes. For the purpose Red K. B. Base (5-chloro-o-toluidine) was mercurated diazotised and then coupled with phenol, resorcinol, o, m- and p-cresols, and p-nitro phenol, α and β -naphthols and o- and p-chloro phenols respectively to give the corresponding azo dyes. The dyeing and fungicidal properties of these compounds are under investigation.

227. Mercurated Dyes, Part III—Preparation of Mercurated Azo Dyes.

V. N. NIGAM, H. L. ROHATGI and A. N. DEY, Kanpur.

In the previous part (part II of the series) we have described the preparation of azo dyes where the mercury was attached to the part of the molecule derived from the base used in their preparation. In this paper we have described the preparation of dyes where the mercury atom is attached to the part formed out of the phenols used in the preparation and thus the dyes obtained from the following combinations are described.

Diazotised bases, viz. Red B base, Scarlet R base Bordeaux G. P. base, Fast Red R. C. base, o-, m-, p-nitro anilines, and o- and p-toluidines were condensed with o- and p-chloro mercuri phenols to give the corresponding mercurated azo dyes. The dyeing and fungicidal properties of these materials will be reported separately.

228. Physical properties of Ghevda Bean Starch Acetate.

R. D. PATEL and R. S. PATEL, Vallabh Vidyanagar.

Out of different methods for preparing starch acetate, use of pyridine, formamide and acetic anhydride with pretreated starch was found most suitable to get undegraded starch acetate. It is also revealed that cereal starches are easily acetylated than pulse starches, but the use of H_2SO_4 as a catalyst degraded the product. The ghevda bean starch acetate was fractionated to get starch acetate fraction of more uniform molecular weight. The intrinsic viscosities and optical rotations were measured in chloroform and benzene.

229. Effect of methods of Acetylation of Starches on the Amylose Content.

R. D. PATEL, R. S. PATEL and U. S. PATHAK, Vallabh Vidyanagar.

Different cereal and legume starches were acetylated to triacetate by different methods. The acetyl content of the triacetates reached nearly the theoretical value. The optical rotation of the triacetates was measured in the suitable solvent. The triacetates were hydrolysed with N/2 alcoholic KOH and the regenerated starches were used for the spectrophotometric determination of amylose content. It has been found that the use of catalyst in the acetylation decreases the amylose content appreciably while acetylation of starches at reflux temperatures decreases the amylose content to a small extent,

230. Studies in Flavonoids. Pongapin analogues.

K. G. MARATHE, Poona.

The syntheses of two pongapin analogues i.e. furoflavonol methyl ethers having a 3, 4-dioxymethylene group in the side of phenyl nucleus is reported. 4-Methyl-6-acetyl-7-hydroxy-coumarin on bromination gave the corresponding 3-bromo-derivative m.p. 220°. The above 3-bromo-4-methyl-6-acetyl-7-hydroxy-coumarin with sodium carbonate yielded 3-methyl-5-acetyl-6-hydroxy-coumarone m.p. 135°. This on condensation with piperonal gave 2'-hydroxy-3''-methyl-3, 4-dioxymethylene-4', 5'-furochalcone m.p. 206°. The chalcone with alkaline hydrogen peroxide yielded 3''-methyl-3', 4'-dioxymethylene-7, 6-furoflavonol m.p. 253-254°. This on methylation furnished β -methyl-isopongapin (linear) m.p. 177-8°. Similarly 3-methyl-6-hydroxy-7-acetyl-coumarone and piperonal gave 2'-hydroxy-3''-methyl-3, 4-dioxymethylene-6', 5'-furochalcone m.p. 162°. The chalcone on oxidation with hydrogen peroxide yielded 3''-methyl-3', 4'-dioxymethylene-5, 6-furoflavonol m.p. 247°. This on methylation gave the corresponding β -methyl-isopongapin (angular) m.p. 201°. Similarly 3-methyl-4-hydroxy-5-acetyl-coumarone and piperonal in the presence of alcoholic alkali yielded 2'-hydroxy-3''-methyl-3, 4-dioxymethylene-4', 3'-furochalcone m.p. 163°. The conversion of the above chalcone into the corresponding flavonol leading to the synthesis of β -methyl-pongapin is in progress.

231. Studies in Flavonoids. Synthesis of α -methyl-dihydropongapin.

K. G. MARATHE and K. R. RAMCHANDANI, Poona.

In continuation of the previous work (cf. preceeding abstract) the present communication deals with the synthesis of α -methyl-dihydropongapin. 3-Allyl resacetophenone was cyclised to 2-methyl-4-hydroxy-5-acetyl-coumaran by the action of cold concentrated sulphuric acid and steam distilling the product. It is a steam volatile liquid characterised by the preparation of its 2, 4-dinitrophenyl-hydrazone m.p. 253°. This on condensation with piperonal gave the corresponding 2'-hydroxy-2''-methyl-3, 4-dioxymethylene-4', 3'-dihydrofuro-chalcone m.p. 154°, 2, 4-Dinitrophenyl hydrazone m.p. 261°. The above chalcone on treatment with alkaline hydrogen peroxide or better with sodium peroxide gave the corresponding 2''-methyl-3', 4'-dioxymethylene-7, 8-dihydrofuro-flavonol m.p. 210°. This on methylation with dimethyl sulphate gave the desired α -methyl-dihydropongapin, m.p. 147°.

232. Synthesis of 3-hydroxy and 3-bromo 3',4' dimethoxy-5-methyl-flavanones.

K. G. MARATHE and R. N. VIDWANS, Poona.

The present communication deals with synthesis of 3-hydroxy-3', 4'-dimethoxy-5-methyl-flavanone. 2'-Hydroxy-5'-methyl-3, 4-dimethoxy-chalcone on bromination gave the corresponding chalcone dibromide m.p. 139-140°. The chalcone dibromide with aqueous acetone yielded a yellow solid m.p. 152-59°. This is in all probability the corresponding 2-hydroxy-5-methyl-phenyl- α -bromo- β -hydroxy-3, 4-dimethoxy-phenethyl ketone as this on treatment with sodium carbonate or sodium acetate gave 3-hydroxy-3', 4'-dimethoxy-5-methyl-flavanone m.p. 156-7°. This with sodium hydroxide yielded 6-methyl-3', 4'-dimethoxy-flavonol m.p. 198°. The chalcone dibromide on keeping in contact with cold glacial acetic acid yielded a substance m.p. 141°. It gave no ferric reaction and on treatment with alcoholic sodium hydroxide yielded the corresponding 6-methyl-3', 4'-dimethoxy-flavone m.p. 189°. Hence the substance m.p. 141° is the corresponding 3-bromo-3', 4'-dimethoxy-6-methyl-flavanone. This on boiling with glacial acetic acid gave substance m.p. 153° giving the same flavone

as above on treatment with alkali. This has also been obtained from the chalcone dibromide m.p. 139-140° by the action of boiling glacial acetic acid or preferably by the addition of bromine to a hot solution of chalcone in acetic acid. Hence it is the isomeric 3-bromo-flavanone. These results are in keeping with the isolation of two isomeric 3-bromo-flavanones in the case of 2'-acetoxy-5'-methyl-4-methoxy-chalcone-dibromide (Bhide, Ph.D. Thesis Poona Univ. 1953) and in the case of 2'-acetoxy-4-methoxy-chalcone-dibromide (Pendse and Limaye *Rasayanam*, 2, 90, 1955). Based on the formulation of Joshi and Kulkarni (*J. Ind. Chem. Soc.* 34, 754, 1957) the stable trans isomer m.p. 152° have been assigned a favoured (2e, 3e) conformation and its cis epimer m.p. 141° (2e, 3a) conformation. The trans bromide is also obtained by the direct bromination of the corresponding 6-methyl-3', 4'-dimethoxy-flavanone m.p. 109° prepared by refluxing the chalcone with alcoholic sulphuric acid. Incidentally 5-methyl-2-(3, 4-dimethoxybenzylidene)-coumaran-3-one m.p. 178° was obtained by the action of hot alcoholic sodium hydroxide on the chalcone dibromide. It gave negative ferric reaction and deep red colouration with concentrated sulphuric acid.

233. Synthesis of 2-veratroyl-3-Hydroxy-5-methyl-coumarone.

K. G. MARATHI[†] and R. N. VIDWANS, Poona.

The present communication deals with the synthesis of 2-veratroyl-3-hydroxy-5-methyl-coumarone from 2'-hydroxy-5' methyl-3, 4'-dimethoxy-chalcone and cis and trans 3-bromo-6-methyl-3', 4'-dimethoxy-flavanones through the corresponding 3, 3'-dibromo-flavanone via 3-bromo-flavone.

2-Hydroxy-5'-methyl-3, 4'-dimethoxy-chalcone on bromination with two molecules of bromine gave a compound m.p. 188-89° $C_{18}H_{16}O_4Br_2$ giving no ferric chloride colouration and could be represented as 6-methyl-3', 4'-dimethoxy-3, 3'-dibromo-flavanone. This was also obtained by the bromination of cis 3-bromo-3', 4'-dimethoxy-6-methyl-flavanone m.p. 141° (cf. preceding abstract) or the corresponding trans compound m.p. 152-3° with one molecule of bromine. The dibromo flavanone by the action of pyridene gave a compound m.p. 156° $C_{18}H_{14}O_4$ Br, which could be formulated as 3-bromo-3', 4'-dimethoxy-flavone by analogy (cf. Diesbach and Kramer *Helv. chim. Acta.*, 28, 1399 (1945)). The above 3-bromo-flavone was treated with alcoholic alkali when a compound m.p. 158° $C_{18}H_{16}O_3$ was obtained. This could also be obtained directly from the dibromoflavanone by the action of excess alkali. This was isomeric with the corresponding known 6-methyl-3', 4'-dimethoxy-flavonol but gave dark green colouration with alcoholic ferric chloride, and is formulated as the corresponding 3-hydroxy-2-veratroyl-5-methyl-coumarone.

234. Synthesis of 4-methyl-daphnetin and 5,6-dihydroxy-4-methyl-coumarin.

K. G. MARATHI[†] and K. I. BHATIA, Poona.

Synthesis of 4-methyl-daphnetin and the corresponding 4-methyl-5, 6-dihydroxy-coumarin is achieved by Dakin oxidation of the corresponding o-hydroxy-acetyl-4-methyl-coumarins. 4-Methyl-7-hydroxy-8-acetyl-coumarin on treatment with alkaline hydrogen peroxide gave a compound m.p. 234-35° and was identified as 4-methyl-daphnetin. Similarly starting from 4-methyl-5-hydroxy-6-acetyl-coumarin on oxidation with alkaline hydrogen peroxide compound m.p. 210° is obtained. This is in all probability the corresponding 4-methyl-5, 6-dihydroxy-coumarin. The identification of this and the preparation of the corresponding 6, 7-dihydroxy-4-methyl-coumarin is in progress.

235. Symmetrical Diazacyanines derived from Thiazoles.

BHASKER DASH and M. K. ROUT, Cuttack.

In the present investigation, the preparation of some diaza trimethin, diaza pentamethin and diaza heptamethin cyanines derived from 4-aryl-2-amino thiazoles have been reported. They were prepared from the corresponding 2-aminothiazole methiodides by treatment with (i) ethyl ortho formate, (ii) 1, 3, 3-trimethoxy propene or (iii) 2, 4-dinitrophenyl pyridinium chloride and alkali respectively. By putting a nitrogen atom in the chromophoric chain, the resonating chain is divided into smaller fragments and as a result, the absorption is shifted to shorter wavelengths. This accounts for the aza cyanine absorbing at shorter wavelength than the corresponding cyanine and the diaza cyanine absorbing at shorter wavelength than the corresponding azacyanine.

236. Trinuclear Cyanine Dyes.

B. K. PATNAIK, P. K. MISRA and M. K. ROUT, Cuttack.

In the present investigation, the synthesis of some trinuclear cyanines of the neo-cyanine type which may be regarded as β -substituted trimethin cyanines have been reported. These have been prepared by the condensation of the meso-methyl trimethin cyanine with p-dialkylamino benzaldehyde. The present work also includes the synthesis of some complex cyanines and merocyanines containing substituted thiazole and quinoline nuclei and substituted rhodanines as the central nucleus. The quaternary salts of the merocyanines containing rhodanine nucleus readily condensed with suitable dye intermediates derived from both basic and acidic nuclei to give complex dyes. The absorption spectra of these dyes have also been studied.

237. Condensation of Aromatic Aldehydes with 5-pyrazolone.

A. S. MITTRA and M. K. ROUT, Cuttack

Benzaldehyde condenses with 1-phenyl-3-methyl-5-pyrazolone under different conditions to produce three interconvertible labile products. Other aromatic aldehydes with electron attracting substituents on the phenyl nucleus also yield three products. Dimethylaminobenzaldehyde produces under acidic or alkaline conditions the same product. The pyrazolone ring is resistant to hydrolysis by alcoholic hydrochloric acid.

238. Formation of the Mono-bromo and Mono-iodo Derivatives of the substituted Malon-monoamides.

G. C. AMIN, R. V. SHAH and M. L. SHAH, Visnagar (N.G.)

Malon-mono-aryl amides have been prepared from the three isomeric tolyl amines, alpha and beta-naphthyl-amines, 1:3:4-xylidine and o-chloro-phenyl-amine. These were converted into the corresponding monobromo and monoiodo compounds. That halogen atom substituted a hydrogen atom of the methylene group and not of the aromatic nucleus is proved by the reduction by means of hydriodic acid.

239. Synthesis of 2,3-dihydroxy-3-methylglutaric Acid.

MOHINDRA S. CHADHA, Trombay.

cis and *trans*-3-Methylglutaconic acids were prepared from ethyl isodelhydracetate via diethyl 3-methylglutaconate following the procedure of Bland and Thorpe (J.C.S., 101, 1565, (1912)). The *cis* acid was also obtained by the dehydration of diethyl 3-hydroxy-3-methylglutarate and hydrolysis of the resulting product. The *trans*-3-methylglutaconic acid could not be hydroxylated using hydrogen peroxide in the presence of tungstic acid. However, the *trans* acid on treatment with sodium chlorate in the presence of osmium tetroxide gave a saturated hydroxy acid believed to be *threo*-2-, 3-dihydroxy-3-methylglutaric acid. The acid was found to exist as an equilibrium mixture with its γ -lactone as indicated by the presence of an absorption band at 5.63μ in the infrared spectrum. Efforts are being made to obtain *threo*-2, 3-dihydroxy-3-methylglutaric acid in a crystalline form. The *erythro* form of the dihydroxy acid is likewise, being synthesised from *cis*-3-methylglutaconic acid.

240. Chemical Investigation of the Root of Adhatoda Vasica.

S. K. SAHA, Calcutta.

The leaf, bark and root of Adhatoda Vasica are reported to make together a better antipyretic combination than any one of them used singly and go by the name of Tribasaka in Ayurveda. Apparently the different parts of the plant are assumed to contain different active principles. Although much work has been done on the leaves of Adhatoda Vasica and a quinazoline alkaloid 'vasicine' isolated and its constitution established, no work seems to have been done so far on the isolation of possible other active principles from the bark and the root. The present paper deals with the successful isolation of a quaternary alkaloid along with vasicine from the root of Adhatoda Vasica.

241. Synthesis of Dibenzotropones and Related Products, Part I.

J. N. CHATTERJEA and H. MUKHERJEE, Patna.

9:10-Dimethoxydibenzocycloheptadiene-1-one-5-carboxylic acid has been obtained by the polyphosphoric acid cyclisation of α -3:4-dimethoxybenzylhomophthalic acid. The former on decarboxylation followed by dehydrogenation by N-bromosuccinimide afforded 9:10-dimethoxydibenzotropone which has also been reached by an unambiguous synthesis from veratrylidene-phthalide following Triebs and Klinkhammer (Ber., 1951, 84, 671). The above new route was applicable in the synthesis of 9:10-diethoxydibenzotropone.

242. Synthesis of Dibenzotropones and Related Products, Part II.

J. N. CHATTERJEA and H. MUKHERJEE, Patna.

α -Benzylhomophthalic acid is shown to give indeno (3:4:3':2') isocoumarin on cyclisation with polyphosphoric acid. The latter has been unambiguously synthesised and converted to 1:2-benzo-4-azafluorene. Several indenoisocoumarins have been synthesised.

243. Synthetical experiments in the 3-Azafluorene Group. Synthesis of 3-Azafluorenone.

J. N. CHATTERJEA and K. PRASAD, Patna.

3-Azafluorenone, hitherto unknown, has now been synthesised from 7:8-benzo-isoquinoline. A new unambiguous synthesis of the latter is also described.

244. Use of 4-Acenaphthene-isothiocyanate for the characterisation of Amines.

JOHN MISQUITTA, Poona.

4-Acenaphthene-isothiocyanate is prepared from commercial acenaphthene by nitration of the hydrocarbon, reduction of the nitro compound and the reaction of the amine with sodium hydroxide, carbon disulphide and lead acetate or nitrate. As a reagent for the characterisation of amines, 4-acenaphthene-isothiocyanate shows a selectivity of action. It does not react with anilines containing negative substituents, like the nitroanilines and the aminobenzoic acids. Neither does it react with the meta isomers of the toluidines, anisidines and phenetidines, the ortho and para aminophenols and secondary amines. It does not react with o-bromoaniline, while the o-chloroaniline it forms a derivative only under forced conditions. Other aromatic amines as well as methyl-, ethyl- and isopropylamine react easily with 4-acenaphthene-isothiocyanate at water bath temperature giving fair yields of well-defined, crystalline and high-melting thioureas which can be used for the characterisation of the amines. Except in the case of the ortho and para anisidines, the melting points of isomeric derivatives differ by more than 5°. The general mechanism of reaction of an isothiocyanate with an amine is discussed and an explanation for the selectivity of 4-acenaphthene-isothiocyanate is suggested.

245. Synthesis of a new Isoflavone.

M. O. FAROOQ, W. RAHMAN and M. ILYAS, Aligarh.

8-Hydroxy isoflavone has been synthesised by the action of ethoxalyl chloride on 2, 3-dihydroxydeoxybenzoin. The intermediate isoflavone-2-carboxylic ester m.p. 160-61° gave on hydrolysis isoflavone-2-carboxylic acid m.p. 260-62°. The acid on decarboxylation was readily converted into isoflavone m.p. 218-20°.

2:3-Dimethoxydeoxybenzoin b.p. 170-73°/2.5 mm. has been obtained in 67% yields by the action of Grignard reagent on 2, 3-dimethoxybenzamide. The dimethyl ether, on demethylation, gave 2, 3-dihydroxydeoxybenzoin m.p. 79-80°. Dihydroxydeoxybenzoin and its dimethyl ether gave crystalline 2, 4-dinitrophenylhydrazones melting at 221-22° and 180-81° respectively.

The preparation of 2:3-Dihydroxydeoxybenzoin and its dimethyl ether have been reported here for the first time. An abnormal product of Grignard's reaction m.p. 52° has also been obtained and is receiving further attention.

246. Synthesis of Thiazoline Compounds and their mercurated derivatives—Part II.

B. B. RAUL and G. N. MAHAPATRA, Cuttack.

Action of Sym-di-(p-tolyl) thiourea on various ketones and their derivatives has been studied in presence of iodine and the resulting thiazoline compounds have been mercurated. The position of the acetoxymercuric group in the p-tolyl nucleus attached to the nitrogen atom at position 3 has been substantiated by

various evidences. These thiazoline compounds have been converted to their corresponding thiazolone derivatives. The fungicidal and bactericidal study of both mercurated and non-mercurated compounds has been done and the mercurated compounds have shown promising fungicidal and bactericidal activity.

247. On the Saponin and Sapogenin of Mahua Oil Cake.

M. O. FAROOQ, I. P. VARSHNEY and MOHD. S. Y. KHAN, Aligarh.

The Mahua oil cake yields a colourless saponin m.p. 186-88°, acetate m.p. 166-68°. This saponin has been shown to be a glycoside of 1, 3, 23-trihydroxy-⁵⁻⁸,¹²⁻¹³-28oleadienic acid(?) or Bassic acid with four sugar residues glucose, arabinose, xylose and rhamnose. A few reactions and derivatives of the genin have been obtained which throw some light on the constitution of bassic acid. The oxidation of bassic acid gives a ketone which reacts with 2, 4-dinitrophenyl hydrazine yielding a hydrazone m.p. 176-78° not reported so far.

248. Decomposition of Carbon Tetrachloride in High Pressure Bombs.

SATISH CHANDRA SRIVASTAVA, Calcutta.

Carbon tetrachloride subjected to 300°C and 150 atm., decomposes to produce hexachlorobenzene in high yield along with carbon, chlorides of metals of which the bomb's body is made and other organic products. The reaction has been studied qualitatively under various conditions between 200°C to 400°C and 5 atm. to 500 atm. in high pressure bombs. It is believed that the reaction involves a free radical $\cdot\text{CCl}$. Possibility of hexachlorobenzene from chlorine and carbon in such experiments is also pointed out.

INORGANIC CHEMISTRY

249. Action of Nitrogen Tetroxide and its Thermal Dissociation Products on Oxides (MgO and Al_2O_3).

VASANTRAI TRAMBAKILAL OZA, Visnagar.

The action of nitrogen tetroxide and its thermal dissociation products on oxides of magnesium and aluminium has been investigated at various temperatures. The main product of the reaction is nitrate accompanied by about half the volume of nitrogen tetroxide consumed of nitrogen trioxide. Interesting observation is with liquid nitrogen tetroxide which is investigated mainly at 30°. Liquid nitrogen tetroxide is found to react with magnesium oxide almost instantaneously when brought into contact with it. It reacted very slowly with oxides of calcium and barium as reported in the literature. But aluminium oxide, an amphoteric oxide, did not react on contact with liquid nitrogen tetroxide and little or no reaction was observed even in contact after three months. But a similar oxide (Zinc oxide) is reported to react almost instantaneously with production of complex yellow viscous product having composition $\text{Zn}(\text{NO}_3)_2 \cdot 2\text{N}_2\text{O}_4$, and this has also been observed by the author. The products of reaction in the case of magnesium oxide at high temperatures is only nitrate uncontaminated with nitrite, while in case of calcium oxide the products of reaction were both nitrite and nitrate.

250. A new complex compound of rhenium with diphenylcarbazone.

R. D. DAFTARY and B. C. HALDAR, Ahmedabad.

A deep violet coloured complex compound of rhenium with diphenylcarbazone has been prepared by the reaction between diphenylcarbazide and potassium perrhenate solution in presence of concentrated hydrochloric acid. It is freely soluble in organic solvents such acetone, chloroform, etc., diamagnetic, and changes into a different substance at 105°C. The absorption spectra of the complex in organic solvents show maxima around 540m μ in the visible region.

251. Basic salts of the monofluoarsenates of bivalent metals—Cu and Ni.

A. K. GUPTA and N. K. DUTT, Calcutta.

The following basic salts of copper and Nickel monofluoarsenates have been prepared and analysed :— $\text{Cu}[\text{AsO}_3\text{F}]$, $4\text{Cu}(\text{OH})_2$, $8\text{H}_2\text{O}$ and $\text{Ni}[\text{AsO}_3\text{F}]$, $4\text{Ni}(\text{OH})_2$, $5\text{H}_2\text{O}$. The basic salts have been prepared by the method of Guy, Fire and Lamure and Ammonium Acetate method.

These salts resemble the corresponding basic sulphates and fluoberrylates in solubility, in number of molecules of water of crystallisation, in behaviour to the action of heat etc.

252. Formation of complex compounds between Uranyl Nitrate and Lead Nitrate: Part VII. The System : $\text{Pb}(\text{NO}_3)_2 \cdot \text{UO}_2(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$ (Conductivity and Spectrophotometry).

C. S. PANDÉ and S. S. GUPTA, Lucknow.

In the present investigation attempts have been made to obtain indication for the existence of complex compounds in the system : lead nitrate-uranyl nitrate-water, by using the physico-chemical properties like conductivity and spectrophotometry. The measurements of these physico-chemical properties of a series of mixed solutions of lead nitrate and uranyl nitrate and their graphical representation against the varying constituent, revealed the existence of two definite complex compounds having the molecular formulæ, viz., (i) $\text{Pb}(\text{NO}_3)_2 \cdot \text{UO}_2(\text{NO}_3)_2$ and (ii) $2 \text{Pb}(\text{NO}_3)_2 \cdot \text{UO}_2(\text{NO}_3)_2$. An attempt is being made to isolate these complexes and to study their properties in detail.

253. Formation of complex compounds between Uranyl Nitrate and Alkaline Earth Nitrates : Part VI. The System : $\text{Sr}(\text{NO}_3)_2 \cdot \text{UO}_2(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$ (Conductivity, pH & Spectrophotometry).

C. S. PANDÉ and S. S. GUPTA, Lucknow.

In continuation of the previous work reported in Part V, of this series, the system : strontium nitrate-uranyl nitrate-water has also been studied. The experimental technique adopted is, to prepare stock solutions of M/10 strength of each of the two salts separately. 5 c.c., of uranyl nitrate (0.1 M) is then pipetted out into a measuring flask of 50c.c. capacity, and the requisite quantity of (0.1 M) strontium nitrate solution are added from a burette, and the solution is made up to the mark by the addition of conductivity water. In this way a set of 27 solutions are made, in which the concentration of uranyl nitrate remains constant (0.01 M), while that of strontium nitrate varies from (0.0 M) to (0.06 M). The physico-

chemical properties, namely, conductivity, pH and spectrophotometry of this set of solutions have been studied. The values of these physico-chemical properties were then plotted against the varying concentration of strontium nitrate. The regular curves obtained indicate two breaks at concentrations corresponding to the compounds having the formulae :

- (1) $\text{Sr}(\text{NO}_3)_2 \cdot \text{UO}_2(\text{NO}_3)_2$ and (2) $2 \text{Sr}(\text{NO}_3)_2 \cdot \text{UO}_2(\text{NO}_3)_2$.

254. Formation of complex compounds between Uranyl Nitrate and Alkaline Earth Nitrates : Part V. The System : $\text{Ba}(\text{NO}_3)_2 \cdot \text{UO}_2(\text{NO}_3)_2 \cdot \text{H}_2\text{O}$ (Conductivity, pH & Spectrophotometry).

C. S. PANDE and S. S. GUPTA, Lucknow.

A survey of literature reveals that uranyl nitrate has a great tendency to form complex compounds with the nitrates of alkali metals, silver, thallium, mercury and cadmium. But the system : barium nitrate-uranyl nitrate-water, has not been thoroughly investigated before. A systematic study of the system now undertaken by us has revealed the existence of two definite complex compounds, viz., (1) $\text{Ba}(\text{NO}_3)_2 \cdot \text{UO}_2(\text{NO}_3)_2$ and (2) $2\text{Ba}(\text{NO}_3)_2 \cdot \text{UO}_2(\text{NO}_3)_2$. A series of mixed solutions were prepared by following Nayar & Pande's Method of Monovariation, i.e., the concentration of uranyl nitrate was kept constant in all the solutions while that of barium nitrate varied systematically. The physico-chemical properties investigated are conductivity, pH measurements and spectrophotometry.

255. 3-Oximinomethylsalicylic acid as an analytical reagent. Spectrophotometric determination of iron.

ASIT KUMAR RAY, Jadavpur.

The use of 3-oximinomethylsalicylic acid as a reagent for the spectrophotometric determination of iron(III) by making use of the orange-red colour formed by $\text{Fe}(\text{III})$ with the reagent in the pH range 5.2–6.8 is described. The wavelength of 400 m μ is most suitable for absorption measurement, where the freshly prepared reagent was found to show little absorption. The pH of the solution should be within the range 5.2–6.8 with at least a molar quantity of the reagent 18–20 times the molar proportion of iron. The colour is stable at room temperature in the pH range mentioned and measurements can be carried out within the range of 20–30°C. Beer's law holds within the range 1.6–14.0 ppm. of iron and sensitivity 0.0147Fe cm.⁻¹. The composition (1 : 3) of the coloured species has been evaluated by Job's method and a probable composition has been assigned. The effect of diverse ions on the colour intensity has been investigated and the tolerance limit has been determined. This method requires a previous separation of iron from the interfering ions as in most other cases.

256. A Thermodynamic Study of some Metal-Biguanide Complexes.

DEBABRATA SEN, A. K. CHAKRABURTTY and N. R. SEN GUPTA, Calcutta.

Thermodynamic dissociation constants of biguanide are given at 20°, 30° and 40°C. Thermodynamic formation constants of complex compounds of biguanide with Cu^{2+} , Ni^{2+} , Zn^{2+} and Cd^{2+} have been determined at three temperatures (20°, 30° and 40°C). While Cu^{2+} , Zn^{2+} and Cd^{2+} give stepwise formation constants for the mono and bis-biguanides, the corresponding nickel complex shows more or less a single step formation. For cadmium the k_2 value has been considered unreli-

able and hence not included in the table as it is too near the precipitation point. These thermodynamic formation constants lead to the evaluation of the free energy, enthalpy and entropy changes for the coordination of biguanide to metal ions.

257. Pyridine Complex of Pentavalent Rhenium.

DEBARATA SEN and BIMANESH SUR, Jadavpur.

Pyridine complex of pentavalent rhenium has been prepared and studied. Analytical data, conductivity and its properties indicate the presence of $[\text{ReO}_2(\text{C}_5\text{H}_5\text{N})_4]^+$ ion.

258. Anionic Manganese (III) Hydroxamic Acid Complexes.

AMIYA KUMAR CHAKRABURTTY, Jadavpur.

In course of a systematic investigation on the metal-hydroxamic acid complexes and their analytical applications, it was observed that manganous salts develop intense purple colouration with different hydroxamic acids in alkaline medium and this was utilised for the colorimetric estimation of traces of manganese. The non-development of these colours in absence of air and the enhancement of the colour reactions in presence of traces of hydrogen peroxide indicate the possible oxidation of manganese (II) to some higher valency state during the complex formation. Investigations of these complexes by Job's method of continued variation as also the study of their electro-chromatographic migration revealed that the complexes are anionic in character in which three molecules of hydroxamic acids are attached to the central manganese ion. These have been isolated in the pure state by precipitating them as salts of the complex cobaltic(III) tris-biguanidinium and chromic(III) tris-biguanidinium cations. Magnetic susceptibilities of these compounds show that the manganese in the complex anion, is in tervalent state of oxidation.

259. Association of uranyl ion with various inorganic anions in aqueous perchloric acid medium.

D. BANERJEA and K. K. TRIPATHI, Calcutta.

From a study of the equilibrium distribution of uranyl ion, as a function of ligand concentration, between aqueous and resin (Amberlite-IR-120, sodium form) phases at pH 3 (perchloric acid) and an ionic strength of 1 M, maintained by adding sodium perchlorate, the formula and formation constants of the complexes formed by uranyl ion with anionic ligands like chloride, nitrate, thiocyanate and sulfate have been determined at 32°C. In the case of nitrate and thiocyanate all the three species with a uranyl: ligand ratio of 1:1, 1:2, and 1:3 seem to exist, while sulfate forms only 1:1 and 1:2 complexes and chloride forms only the 1:1 complex even at a chloride concentration of 1,000 times that of uranyl ion. The formation constants for the various species are given.

260. A note on the preparation of hypoglycemic biguanide (PEDG).

S. L. LASKAR and S. ROYMAHASAY, Calcutta.

In recent years the introduction of some orally effective hypo-glycemic agents have greatly stimulated interest in oral diabetic therapy. Dr. Ungar and Dr. Louis

Freedman (Proc. oc. Expt. Biol. 95(1), 190-193, 1957) reported the high hypoglycemic activity of a biguanide compound, Beta-Phenethyl-formidinylinourea (PEDG). Its synthesis as reported by Seymour L. Shapiro et al (J. Am. C.S. 79, 5064, 1957) was by the fusion of Beta phenethylamine hydrochloride and dicyandiamide at an elevated temperature. Biguanide compounds are also reported to have been conveniently prepared by refluxing the appropriate amine, dicyandiamide and ammoniacal copper sulphate or chloride and decomposing the copper complex with Sulphuretted hydrogen. The present work was undertaken with a view to study the synthesis of PEDG by refluxing beta-phenethylamine, dicyandiamide and ammoniacal copper sulphate or chloride. The method was found to yield copper complex in good yield. The copper complex gave biguanide sulphate, mono and dihydrochlorides at controlled acidity on de-composition with sulphuretted hydrogen in high state of purity.

261. Studies on Periodates.

D. CHAKRABARTTY, K. N. ROY and B. N. GHOSH, Bombay.

A survey of the literature indicates the existence of various types of periodates of a metal (especially of a tri-, tetra- and pentavalent one). No two authors agree on the composition of the periodate of a metal. In order to rule out the existence of such diversity of formulae and composition of periodates of heavy metals, work has been undertaken in this laboratory. Periodates of bismuth have been prepared and some analyses have been carried out and reported. Probable structures of the periodates may be elucidated by magnetic susceptibility measurements which are in progress.

262. Study of the Pyridine Complexes of Nickel Sulphate by Siddhanta's Modified Method of Continuous Variation.

P. C. SINHA and RAI J. N. SAHAYA, Patna.

Complex formation between pyridine and nickel sulphate in aqueous solution has been studied calorimetrically by Siddhanta's modification of Job's method of continuous variation, using molar heat content as the indicative property. The composition of the complex under the conditions of the experiment is mainly $[\text{NiPy}_2]^{++}$ but there is indication the complex or complexes with higher pyridine content are present in solution ; the dissociation constant is approximately 3.5×10^{-4} (mean value).

263. Studies on the Composition and Structure of Chromium(1)-Sulphato-Hydrazinate.

S. M. FAZLUR RAHMAN and NURUL ISLAM, Aligarh.

Chemical analysis of the precipitate obtained by mixing chromium sulphate and hydrazine hydrate was undertaken to determine the composition of the complex. The composition was found to be $\text{Cr}_2\text{SO}_4 \cdot 2\text{N}_2\text{H}_4 \cdot 3\text{H}_2\text{O}$.

The precipitate loses one molecule of water over conc. H_2SO_4 and on heating to $110-120^\circ$ all the three molecules were lost. The probable structure can be $[\text{H}_4\text{N}_2-\text{Cr}-\text{OSO}_2\text{O}-\text{Cr}-\text{N}_2\text{H}_4]\text{H}_2\text{O}$ the sulphato-bridging being supplied by the sulphate H_2O . H_2O

from one of the reactants. The possibility of the existence of a four coordination compound of $\text{Cr}(\text{I})$ has been discussed.

264. Organic Salts of Bivalent Chromium.

R. C. MEHROTRA and J. P. TANDON, Gorakhpur.

The preparation of a number of organic salts of bivalent-chromium has been undertaken. Salts of the saturated (adipic, sebacic, camphoric, phenyl-acetic and lauric), unsaturated (cinnamic), aliphatic hydroxy (benzilic), amino (phenyl-glycine, p-aminobenzoic and hippuric), and aromatic halogen-substituted carboxylic (O-chlorobenzoic) acids have been prepared, for the first time and their properties have been compared with corresponding compounds of trivalent chromium.

The characteristic colours of some of the above derivatives can be used for the detection of bivalent chromium ions. The nature of these salts has been discussed in view of earlier suggestion of King and Garner (1950).

265. "Reactions of Titanium Tetrachloride with Hydroxylic and Carboxylic Compounds".

R. C. MEHROTRA, Gorakhpur.

The reaction of titanium tetrachloride with alcohols to yield dichloride derivatives has been known for a long time. It has been shown that the reverse reaction of titanium tetra-alkoxides with excess hydrogen chloride results in the same dichloride derivatives.

The reaction of titanium tetrachloride and carboxylic (acetic, propionic, butyric and benzoic) acids has been found to yield dichloride di-carboxylate derivatives directly. Further reaction is much slower and is accompanied by side-reactions resulting finally in a complex derivative of titanyl oxalate type.

The reaction of titanium tetrachloride with diketones has been reinvestigated in detail and it has been confirmed that the main derivative in these cases also is a dichloride diketone derivative. However, contrary to the assumptions of earlier workers, the derivatives have been shown to be monomeric compounds by a variety of physico-chemical investigations and their simple relationship with dichloride dialkoxide derivatives has been clearly demonstrated.

Contrary to the above general pattern, the reaction of titanium tetrachloride with phenols has been found to result in the replacement of all the four chlorine atoms and yield tetra-phenoxy derivatives directly.

A simple plausible explanation has been suggested for all the above findings and attempts have been made to explain the reported variation in the reactivity of tetrachlorides of other elements of group IV towards hydroxylic and carboxylic compounds.

266. The preparation of Uranium Tetrafluoride.

BALARAM SAHOO and D. PATNAIK, Cuttack.

The preparation of uranium tetrafluoride with one molecule of water at ordinary temperature by the action of hydrofluoric acid on uranium (IV) oxyacetate has been achieved. Uranium (IV) oxyacetate was prepared by the photolysis of uranyl acetate in presence of acetic anhydride and alcohol. The tetrafluoride is obtained as a bluish green compound and the reaction is exothermic.

267. The Photolytic Separation of Uranium from Beryllium and Zirconium.

K. SINGH, BALARAM SAHOO and D. PATNAIK, Cuttack.

The photolytic process of isolation of the hydrated ammonium uranium fluoride complex $\text{NH}_4\text{F} \cdot \text{UF}_4 \cdot \text{H}_2\text{O}$ has been applied for the separation of uranium from beryllium and zirconium, utilising sunlight as the source of energy. For this purpose the mixture of the solutions of uranium and beryllium or zirconium with ammonium bifluoride containing 20 per cent alcohol at different pH were exposed to sunlight for 5-6 hours. Uranium was precipitated in the form of hydrated complex fluoride leaving beryllium and zirconium in solution. The solution containing the unprecipitated uranium can be further used for its extraction, thus causing no loss of uranium.

268. Photolytic Separation of Uranium from Titanium and Molybdenum.

K. SINGH and D. PATNAIK, Cuttack.

The separation of uranium from titanium and molybdenum has been accomplished by photolytic process. Sunlight has been used as the source of energy for photolysis. Uranium is precipitated as hydrated uranium fluoride complex ($\text{NH}_4\text{F} \cdot \text{UF}_4 \cdot \text{H}_2\text{O}$), when a mixture of uranium with titanium or molybdenum is exposed to sunlight with NH_4F and alcohol, leaving titanium and molybdenum in solution. The effect of alcoholic composition and that of pH have been studied. With 20% alcohol by volume and at pH 2.5 over 95% of uranium of 99.9% purity has been recovered.

269. Hydrated Compounds of Uranium from Uranium (IV) Oxycarbonate.

BALARAM SAHOO and D. PATNAIK, Cuttack.

The uranium (IV) oxycarbonate has been isolated by us. The compound undergoes simultaneous oxidation and dehydration when exposed to dry air producing hydrated uranyl carbonate. A number of uranium (IV) compounds, namely, uranium tetrafluoride, uranium (IV) oxyformate, oxyacetate, dioxalate and oxynitrate, have been synthesised, utilising the oxycarbonate as the starting material. In each case hydrated compounds have been formed. Conditions of preparation remaining unaltered, the varying number of water of hydration has been ascribed to be dependent on the nature of formation. Other properties of the compounds, such as, intensity of colour, crystal size etc. have also been explored.

270. Corrosion Inhibition of Aluminium in Acid Solutions : Inhibitor Efficiencies.

J. SUNDARARAJAN and T. L. RAMA CHAR, Bangalore.

The corrosion rates of commercial aluminium have been determined in hydrochloric acid solution under various conditions. The inhibitor efficiencies have been calculated for acridine, thiourea, dextrin, and nicotinic and tannic acids. The first two are the best inhibitors.

271. Study of Thiosalts—Part I, Formation of Thiosalt from Mercuric Sulphide.

K. P. DUBEY and S. GHOSH, Allahabad.

The dissolution of mercuric sulphide in alkaline sulphides has been studied. It has been confirmed that the compound Na_2HgS_2 is formed and the formation is complete in alkaline sulphide containing a large excess of free alkali. The stability constant for the reaction $\text{HgS} + \text{S}^{-2} \rightleftharpoons (\text{HgS}_2)^{-2}$ has been calculated and the value obtained is approximately 12. The values for the stability constant obtained are almost same for sodium and potassium sulphides; in other words, the solubility of mercuric sulphide is the same in sodium and potassium sulphides.

272. Complexes of Titanium and Zirconium Tetrachlorides in Thionyl Chloride.

SARJIT SINGH SANDHU, BHUPINDAR SINGH CHAKKAL and GURMIT SARJIT SANDHU, Hoshiarpur.

The electronic configuration of titanium and zirconium tetrachlorides which is d^2s provides ample chances for the molecules to acquire more suitable structure d^2sp^1 through chemical combination. The complexes of the two tetrachlorides with quaternary ammonium chlorides such as tetramethylammonium chloride, trimethylphenylammonium chloride, trimethylbenzylammonium chloride, dimethylphenylbenzylammonium chloride and triethylbenzylammonium chloride and heterocyclic bases pyridine and quinoline, have been prepared in thionyl chloride. As a result of this investigation fourteen complexes have been isolated. The quaternary ammonium

 R_4

chlorides yield complexes of the type $\left[\begin{array}{c} \text{R}_1 - \text{N} - \text{R}_2 \\ | \\ \text{R}_3 \end{array} \right]^+ \text{MCl}_4$ while the complex of

pyridine and quinoline correspond to the types $(\text{C}_5\text{H}_5\text{N})_2 \text{MCl}_4$, SOCl_2 and $(\text{C}_8\text{H}_7\text{N})_2 \text{MCl}_4$ respectively. This mode of formation of these complexes through ionization of the tetrachlorides and bases has been suggested.

The reasons for the partial loss of solvent molecules in the second type of complexes and total loss of the solvent in the third type of complex has been explained on the grounds that nitrogen in these heterocyclic systems possesses sp configuration and the presence of M bond confers a certain amount of strain upon the molecule. Even on combination with solvent molecule and on subsequent ionization the thionyl pyridinium and thionyl quinolinium ions are not very stable entities. Moreover, the steric effect of thionylum ion must also be taken into consideration. In spite of the loss of solvent, the metallic atom still exhibits hexacovalency (d^2sp^1) in all these complexes. The second type contains only mono negatively charged anions with one pyridine molecule linked through co-ordination to the central atom while the second pyridine molecule exists as thionyl pyridinium cation. Of course the third type provides purely covalent complexes and here both the quinoline molecules are directly linked with the metallic atom through co-ordination.

273. The formation of the complex compound of copper by the reaction between copper sulphate and diphenylcarbazide.

S. P. THAKUR and B. C. HALDAR, Ahmedabad.

Diphenyl carbazide reacts with copper sulphate solution to produce a compound of the formula $\text{CuC}_{25}\text{H}_{28}\text{N}_4\text{O}_2$. The compound is insoluble in water and ethyl alcohol. It is paramagnetic, the effective magnetic moment being 1.72 B.M. The acetone solution of the complex shows maximum absorption at $540\text{m}\mu$. It is suggested that the spectra is of the charge transfer type and overlaps the weak $d-d$ spectra in the visible.

274. Photolytic Separation of Uranium from Aluminium.

I. B. MISHRA, K. K. TRIPATHY and D. PATNAIK, Cuttack.

The separation of Uranium from aluminium has been accomplished by two different methods, viz. the photolysis of the mixed sulphates and the photolysis of the mixed formates. When a mixture of uranyl sulphate and aluminium sulphate is exposed to sunlight for 6—7 hours in presence of formic acid and alcohol, uranium is precipitated as hydrated uranium (IV) Oxysulphate. The uranium thus precipitated is found to be pure to the extent of 99.9%, the percentage of recovery being 93% in 50% alcohol. When a mixture of formate solutions of uranium and aluminium with a little of ammonium nitrate (to coagulate the precipitate) is exposed to sunlight for 24 hours, uranium precipitates as hydrated oxide, leaving aluminium in solution, 93% uranium being recovered with a purity of 99.9%. However, when the mixture of the formates acidified with formic acid, was exposed the reduced uranium (IV) in solution could be quantitatively precipitated by addition of sodium hydroxide, leaving aluminium in solution as aluminate. The precipitate is contaminated with sodium, which on second precipitation with ammonium hydroxide, is eliminated.

275. Derivatives of Beryllium with 2-Hydroxy 3-Naphthoic Acids.

R. C. MEHROTRA and R. P. AGARWAL, Gorakhpur.

The reaction of beryllium salts with 2-hydroxy 3-naphthoic acid has been investigated in detail by preparative, conductometric and electrometric techniques. Two new compounds $\text{Be}(\text{C}_{11}\text{H}_7\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$ and $\text{Be}(\text{C}_{11}\text{H}_7\text{O}_2)_2$ have been isolated. The formation of these compounds in solution also is confirmed by physico-chemical methods and probable structures are assigned keeping the co-ordination number of beryllium as 4. The physical properties of the compounds themselves support the proposed formulations.

276. Derivatives of Magnesium and Zinc with 2-Hydroxy 3-Naphthoic Acids.

R. P. AGARWAL, Gorakhpur.

In view of our earlier work with beryllium naphthoates, similar studies have been carried out with magnesium and zinc salts. The magnesium naphthoates have been found to be soluble in water, from which they have been crystallised. The dinaphthoate can be prepared by reacting magnesium sulphate with excess of potassium naphthoate, whereas the mono-derivative could be prepared only by reacting magnesium sulphate, potassium naphthoate and sodium bicarbonate in equimolecular ratio. Zinc dinaphthoate is insoluble and gets precipitated when potassium naphthoate solution is added to a zinc salt. The physico-chemical properties of these derivatives have been studied and compared with those of beryllium.

277. "Reactions of Ethyl and Isopropyl Titanates with α -Hydroxy Carboxylic Acids.

I. D. VERMA and R. C. MEHROTRA, Poona and Gorakhpur.

Stepwise replacement of alkyl groups of ethyl and isopropyl titanates by acyl groups of lactic, mandelic, and salicylic acids has been investigated by taking reactants in predetermined stoichiometric proportions and causing them to react in refluxing benzene. The number of alkyl groups replaced in reaction was determined by estimating alcohol liberated in reaction and by analysing reaction pro-

duct. When alkyl titanates are acted upon by 2 moles of these acids, salicylic acid liberates 4 moles of alcohol (per mole alkyl titanate) where as remaining two acids displace only 3 or 3.5 moles of alcohol. Thus di-lactate and mandelate derivatives appear to with-hold very firmly (remaining) alcohol as adduct. However, with 3 moles (or higher proportions) of these acids, alkyl titanates yield, in every case, an equimolecular mixture of di- and tri-acylates.

All these acylates are white solids, but for salicylates which are orange or deep red in colour. Monolactate, salicylate and mandelate derivatives are soluble in benzene, whereas the equimolecular mixture of di- and tri-lactate dissolves in water without hydrolysis.

278. Preparation and Properties of Chromous Oxinate.

R. C. MEHROTRA and J. P. TANDON, Gorakhpur.

There has been a controversy in the literature about the existence of chromium (II) oxinate. The preparation of the salt has been studied under a variety of conditions and it has been found that pure chromium (II) oxinate is precipitated by adding a solution of oxine to a large excess of chromous chloride or sulphate solution prepared by dissolving chromous acetate in minimum amount of the acid. A large number of samples with analyses corresponding to $\text{Cr}(\text{C}_8\text{H}_7\text{ON})_2$ have been prepared. The compound appears to undergo an intramolecular change.

279. Studies on the Preparation and Properties of Uranium (IV) Nitrate.

T. R. BHAT and B. S. MATHUR, Trombay.

Uranium (IV) nitrate has been prepared by the photo-chemical reduction of nitric acid solutions of uranyl nitrate in presence of ethanol and by the reaction of uranium (IV) sulphate and barium nitrate and of uranium (IV) chloride and silver nitrate. Hexavalent uranium was removed from the tetravalent uranium by solvent extraction with 5–10% tributyl phosphate (TBP) in kerosene solution and later the uranium (IV) nitrate was separated from other impurities by 20% TBP extraction.

The oxidation of uranium (IV) nitrate in aqueous and TBP solutions under different conditions, in air and nitrogen atmosphere has been studied.

Attempts to isolate solid uranium (IV) nitrate was not successful. Uranium (IV) nitrate was found to form a complex with TBP of the type $\text{U}(\text{NO}_3)_4 \cdot 2\text{TBP}$.

280. A Study on the Complex Formation of Beryllium with Salicylic Acid and Sulpho-Salicylic Acid.

REBATI CHARAN DAS and S. ADITYA, Cuttack.

Beryllium perchlorate forms colourless complex with both Salicylic Acid and Sulpho-Salicylic Acid. The nature of these complexes has been studied by ultraviolet spectrophotometry. The absorption spectra at different pH suggests that the complex formation increases with the increase of pH. The compositions of these complexes were studied at pH 4.5 by Job's method of continuous variation. The mole ratio of Beryllium to the ligand in both the complex ions is 1 : 1. The values of stability constants were determined at ionic strengths 0.02, 0.05, 0.1 and 0.2 M respectively for the Beryllium-Salicylic Acid complex, and compared with those of the Beryllium-Sulpho-Salicylic Acid complex at the same ionic strengths. The thermodynamic stability constants have been found by extrapolation. They are 1.583×10^4 and 3.511×10^4 for Salicylic Acid and Sulpho-Salicylic Acid complexes res-

pectively. The value of ΔF are calculated to be -5822 cal. and -6302 cal. for the same two complexes.

281. Structure of complex compounds of Palladium, Nickel and Copper with Salicylidene Thiosemicarbazone.

S. P. GHOSH and Y. THAKUR, Patna.

Complex compounds of palladium, nickel and copper have been prepared with salicylidene thiosemicarbazone. They can be represented by the general formula; $M(C_8H_7ON_3S).NH_3.XH_2O$. The nickel and palladium complexes were found to be diamagnetic and therefore to have square-planar structures with dsp^2 bonding. The copper complex, black in colour, was also diamagnetic and hence it is suggested to be a cuprous complex.

282. Application of the New Colour reaction for Cyanide and Thiocyanate to the Determination of Metal.

G. S. DESHMUKH and S. V. TATWAWADI, Varanasi.

Most of the commonly occurring cations and anions had no effect upon the cyanide-pyridine-chloramine T reaction and the subsequent development of the yellow colour. A few metallic ions, such as copper, nickel, cobalt, silver and gold, however, decreased the intensity of the yellow colour, the change being proportional to the concentration of the cations present in the solution. Cobalt, nickel and silver reacted stoichiometrically with cyanide, 1 mole of each of these metals reacting with 5, 4, and 2 moles of cyanide respectively. No stoichiometry of gold and copper with cyanide could be established under the experimental conditions. There was no evidence for the existence of a cabalto-hexacyanide in the aqueous solution; instead, formation of a pentacyanide of cobalt has been suggested.

283. The Action of Nitric Oxide on Oxides of Silver, Mercury and Calcium.

T. M. OZA, R. H. THAKER and G. T. OZA, Bombay.

The action of nitric oxide at pressures less than one atmospheric and at pressures tending zero has been studied on a fixed mass of oxide of silver, of mercuric mercury and of calcium, at temperatures below those at which the nitrites formed begin to decompose. The only solid product formed with CaO and HgO is the nitrite while in the case of Ag_2O both nitrite and nitrate are produced and also silver metal. The gas which was pure nitric oxide at the start of the experiment contained some nitrogen dioxide and nitrogen at the end. Experiments at pressure of nitric oxide tending to zero showed enhanced formation of nitrogen. As temperatures used preclude the possibility of the thermal decomposition of nitric oxide and pressure is found to have great influence, it appears that catalytic decomposition of nitric oxide occurs. The formation of nitrite (nitrate in the case of Ag_2O) in the solid phase accompanied by that of nitrogen and nitrogen dioxide is an interesting aspect of this work.

284. The Decomposition of Mercuric Nitrite.

T. M. OZA and KUMARI E. I. EZEKIEL, Bombay.

The decomposition of pure mercuric nitrite (a) in solution (b) in the solid state is studied below 140° and the products examined by a quantitative study of the

residues left and gas formed under different conditions. The decomposition is found to lead to the formation of (i) in the wet state, mercurous and mercuric nitrates and nitric oxide (and nitrogen dioxide), (ii) in the dry state, mercuric nitrate, nitric oxide (and nitrogen dioxide). In either case the reactions leading to the formation of the final products proceed through the primary decomposition of the nitrite into mercuric oxide, nitric oxide and nitrogen dioxide.

ANALYTICAL CHEMISTRY.

285. Determination of "Bound" Formaldehyde in Formaldehyde—Peptone Mixtures—Part II.

V. SUBBA RAO, Waltair.

Estimation of "bound" formaldehyde content by two different methods, formal titration and chromotropic acid method after Vorländer's reaction in products obtained by exposing peptones to formaldehyde vapour and later drying them over phosphorus pentoxide was described previously. The values obtained by both these methods agreed closely. It was found that about 30-35 mg. of formaldehyde was "bound" by a gram of peptone. It was also reported that when these products were dissolved and the solutions stored at room temperature for seven days, this "bound" formaldehyde content decreased by 30%.

The problem was investigated further by estimating the formaldehyde contents of the above products by chromotropic acid method before performing the Voländer's reaction. The values obtained were much higher than the "bound" formaldehyde contents (60-90 mg. of HCHO per gram of peptone) and are designated as "total" formaldehyde contents.

It has been found that the "bound" formaldehyde contents were different when (1) peptone was allowed to absorb formaldehyde vapour and (2) an equivalent quantity of formaldehyde was added as a solution. Perhaps this might be due to formaldehyde binding differently to peptone when allowed to react with it as vapour and as solution. The actual functional groups involved in these bindings is under investigation.

286. Dalzine (Diallyl dithiocarbamido-hydrazine) as a Micro-Reagent. I. Estimation and Separation of Copper and Nickel.

N. K. DUTT and A. DUTTA AHMED, Calcutta.

The reagent has been used by one of us (Dutt) and K. P. Sen Sarma (N. K. Dutt and K. P. Sen Sarma. *Anal. Chim. Acta* 15, (1956), 21; *Ibid*, 15, (1956) for the gravimetric determination of bi-valent metals like copper, nickel, zinc, mercury, lead, palladium and also silver by Macro-method. Low percentage content of metal in the compounds and the accuracy of the results obtained by the Macro-method suggested a Micro-adaptation of the same.

A description of the Micro-method for the estimation and separation of copper and nickel together with the results of a number of such determinations is given in the present paper.

The precipitation of Cu and Ni was carried out in a micro-beaker and the filtration and washing were effected by means of Emich's asbestos packed filter-stick. The beaker and the filterstick containing the precipitate were dried in the Benedetti-Pichler's drying apparatus in a current of air. Weighings were made in a Mettler Single-pan Micro-Balance.

In the Micro-estimation almost the same procedure was followed as was described for the Macro-method (*loc. cit.*).

287. Polarographic study on copper(II) biguanide chelate.

BISWANATH CHAKRAVARTY and ASIT KUMAR ROY, Calcutta.

It has been shown by Rây and co-workers that biguanide and substituted biguanides form well defined crystalline complex compounds with various metallic ions.

In the present work the reduction of copper (II) biguanide complex in 0.1M KCl and 0.01% gelatine at the Hg-electrode has been studied. From these studies attempts have been made to calculate the half wave potentials of the various cupric and cuprous biguanide complexes reduced at the Hg-electrode. In the presence of the complexing agent the half-wave potentials of Cu^+ ion is shifted to a more negative value (here -0.5125 volts vs. S.C.E.) than that for the cupric ion (here -0.17 volt vs. S.C.E.). This shift in the half-wave potentials is expected. The same is true in the case of the various copper ammonia complexes. It has been found that in the latter case the standard potential and the half-wave potential of the $\text{Cu}^+ \rightarrow \text{Cu}(\text{Hg})$ system is usually shifted in the negative direction to a greater extent than that of the $\text{Cu}^{++} \rightarrow \text{Cu}^+$ system, and the polarogram shows a double wave. The value of i for the second wave has been calculated to be 3.184 micro amperes.

The values of the half-wave potentials for the first, second and third wave noted from the polarogram agrees fairly well to the values obtained from the plot of $\log \frac{i}{i_1 - i}$ vs. $-E_{\text{d.e.}}$ for these respectively.

The polarogram of the biguanide molecule was also studied in 0.1M KCl and 0.01% gelatine. The half-wave potential for the reduction of biguanide molecule at the Hg-electrode is found to be -0.96 volts. vs. S.C.E.

288. N-Benzoylphenylhydroxylamine as an Analytical Reagent : Part I—Colorimetric Determination of Iron and Copper.

H. R. DAS and S. C. SHOME, Calcutta.

N-Benzoylphenylhydroxylamine has been employed as an organic reagent in the colorimetric determination of iron and copper and their separation from each other. The iron derivative of the organic reagent dissolves readily in either chloroform or ether giving a red solution. The solution of iron derivative in ether shows maximum absorption at a wavelength of $438\text{m}\mu$. The copper derivative of benzoylphenylhydroxylamine is appreciably soluble in chloroform producing a greenish yellow solution which indicates a total absorption at wavelengths ranging from $260\text{m}\mu$ to $300\text{m}\mu$. The copper complex is insoluble in ether.

The ferric ion can be completely extracted from its aqueous solution in the pH range 2.25 to 2.45 by shaking with 0.01M solution of benzoylphenylhydroxylamine in ether. The cupric ion, however, cannot be extracted by the same solvent. Iron has been quantitatively separated from copper by the ether extraction in the pH range 2.25 to 2.45. The iron complex has also been extracted using other solvents such as chloroform, ethylacetate, and nitrobenzene. After the removal of iron by the ether extraction, copper can be estimated by treating the aqueous solution at pH 3 to 4, with benzoylphenylhydroxylamine solution in chloroform (0.1M).

289. 3-aldehydo salicylic acid ethylenediamine schiff's base as an analytical reagent : Spectrophotometric determination of uranium.

SATYENDRA CHANDRA LODH, Jadavpur.

The use of 3-aldehydo salicylic acid ethylenediamine schiff's base as a reagent for the spectrophotometric determination of uranium (VI) by making use of the

orange-red colour formed by uranium (VI) with the reagent in alkaline solution, is described. The wavelength of 470 m μ is found most suitable for absorption measurement. The optimum pH of the solution lies between 8.90 and 10.20 with an excess of the reagent, at least 8 to 10 times the molar proportion of uranium for the maximum development of colour. The colour is stable at room temperature below 35°C. Beer's law holds good in the range of concentration 7–145 p.p.m. uranium. Sensitivity 0.117 U cm⁻². The composition (1 : 1) of the coloured species has been evaluated by Job's method and the probable constitution has been suggested. Most cations and anions interfere with the determination of uranium. Hence a preliminary separation of uranium from the interfering ions is essential.

290. Mercurimetric Determination of complexly and ionically bound thiosulphate and sulphite in chrome liquors.

D. RAMASWAMY and Y. NAYUDAMMA, Madras.

The determination of thiosulphate and sulphite both complexly and ionically bound is important in two bath tannage and other sulphite masked liquors. The present method makes use of the electrometric titration against mercuric chloride with mercury pool electrode and saturated calomel electrode. The total sulphite and thiosulphate ionically bound is first found by straight titration with mercuric chloride and thiosulphate alone by binding the sulphite with formaldehyde. The complexly bound sulphite and thiosulphate were first displaced by oxalate and acid and titrated separately in the presence and absence of formaldehyde. The presence of sulphate does not interfere in the method of determination.

291. Volumetric Method for the Determination of Gold in Presence of Copper & Iron.

M. R. VERMA, V. M. BHUCHAR and I. H. SUBHERWAL, New Delhi.

In a neutral solution gold reacts with potassium iodide to liberate an equivalent amount of iodine. If the determination is attempted in presence of copper, there will be an interference. If, however, determination is carried out after complexing copper with alkali oxalate, the estimation of gold can be carried out without any interference from copper. Interference from iron can likewise be avoided by adding alkali fluoride. Very satisfactory determinations of gold have been carried out in solutions having gold : copper : iron in the ratio 2 : 8 : 12. The determination requires a correct sequence of addition of the alkali fluoride, bicarbonate, oxalate, iodide for various stages of the reaction and low temperature for satisfactory determination.

292. Paper Chromatographic Method for the Identification of α - and β -Naphthols in the Presence of One Another.

M. R. VERMA, RAMJI DASS and P. K. GUPTA, New Delhi.

Chemical methods for the identification of α - and β -naphthols in the presence of one another are difficult. But if these are condensed with diazotised Amino-J.-Acid and the dye spot chromatographed on a piece of filter paper using iso-amyl alcohol-ethyl alcohol-ammonia or methyl iso-butyl ketone—ethyl alcohol—liquor ammonia as the developing agents fairly distinctive, R_f values for the derivatives of α - and β -naphthols are obtained. This method can be used for the identification of two phenols from their mixture.

293. Colorimetric Method for the Estimation of Trivalent Chromium.

M. R. VERMA, V. M. BIJCHAR, K. C. AGRAWAL and R. K. SHARMA,
New-Delhi.

Chromium can be estimated from a number of combination by converting it into dichromate and estimating the same volumetrically and colorimetrically. A direct method for the estimation of trivalent chromium has been developed. Chromium on boiling with chenta acid, forms a violet coloured complex at pH 4-5 with max absorption at 542 m μ . The solution obeys Beer's law and satisfactory determinations have been made out a wide range of concentrations. This method, it is envisaged, has many applications in several determinations of technical importance.

294. Determination of Phthalyl Sulphacetamide, Chloroquine and Di-iodo-hydroxy-quinoline in a Mixture.

S. BHATTACHARYA, Calcutta.

A combination of di-iodohydroxyquinoline, chloroquine phosphate and phthalyl sulphacetamide is often used in the treatment of dysentery—both amoebic and bacillary. Difficulty often arises in analysing the individual constituents of such a mixture especially in case of phthalyl sulphacetamide. In a mixture where di-iodohydroxyquinoline is present, the addition of sodium nitrite to the mixture for the diazotization of the amino group of phthalyl sulphacetamide also liberates iodine from di-iodohydroxyquinoline. As such it is necessary to separate the phthalyl sulphacetamide from the other constituents particularly from the di-iodohydroxyquinoline.

In the process of separation advantage has been taken of the preferential solubility of the phthalyl sulphacetamide in sodium bicarbonate solution. Chloroquine phosphate could be separated in a second sample by extracting with water, the other two constituents being insoluble in water. Di-iodohydroxyquinoline, however, can be assayed even in presence of the other two.

The details of the process has been discussed.

295. Colorimetric Method for the Submicroestimation of Sugars.

S. BOSE, S. MUKHERJEE and A. N. SHRIVASTAVA, Kanpur.

The orange-yellow colour developed when sugars are treated with phenol and concentrated sulphuric acid has been measured with spekker photoelectric colorimeter (Hilger and Watts Ltd., England) using Ilford filter No. 602. It is observed that glucose, galactose and fructose under this condition obey Beer's law in the concentration range of five to twenty micrograms per ml. whereas in case of arabinose the concentration range obeying Beer's law is found to be five to twenty-five micrograms per ml. Investigations on other sugars are in progress.

296. Analytical aspects of some Organic Acids : Part V. Back Titration Procedures for the Determination of Aluminium, Zirconium and Thorium with Iron (III) Solution and 2-Hydroxy-3-Naphthoic Acid-Indicator.

C. S. PANDE and T. S. SRIVASTAVA, Lucknow.

Back titrimetric procedures for the estimation of aluminium, zirconium and thorium have been developed, which involved the adjustment of the concentration

of the metallic salts, concentration of EDTA, pH, temperature, addition of indicator solution (namely, 2-hydroxy-3-naphthoic acid) and back titration with standard M/10 ferric chloride solution. This method is based on the fact that the excess EDTA, which is added to the metal solutions may be back titrated with iron (III), which forms highly coloured complex with indicator when present in slight excess. Quantities of aluminium, zirconium and thorium as small as 10.8, 4.6, 11.6 mg. can be back titrated within experimental error, when present in a volume of 100 ml.

297. Analytical aspects of some Organic Acids—Part IV. Direct Complexometric Titration of Iron (III) with EDTA Using 2-Hydroxy-3-Naphthoic Acid as Indicator.

C. S. PANDE and T. S. SRIVASTAVA, Lucknow.

A direct titrimetric method for the estimation of iron (III) has been developed, which involved the adjustment of concentration of iron (III), pH, dilution, addition of 1 ml. of 2% indicator, temperature (30° to 35° C) and titration with EDTA. It is based on the fact that the iron (III) forms a blue coloured complex which is destroyed at the (1:1), molar ratio, making the end-point of the titration. Quantity of iron (III) as small as 23.2 mg. can be titrated accurately when present in a volume of 100 ml. Study of interferences revealed that quite a number of elements like Be^{2+} , Mg^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , UO_2^{2+} and Mn^{2+} do not interfere, whereas heavy interference is caused by Cu^{2+} , Zn^{2+} , Pb^{2+} , Fe^{2+} , Co^{2+} , Ni^{2+} , ZrO^{2+} , VO^{2+} , Al^{3+} , Cr^{3+} , Ti^{4+} , Ce^{4+} and Th^{4+} . The method proposed for iron (III) is selective and should be of considerable use in many cases.

298. Analytical aspects of some Organic Acids : Part VI. Direct Complexometric Titration of Iron (III) with Disodium salt of Ethylenediaminetetra-acetic Acid (EDTA) using o-Cresotic Acid as Indicator.

C. S. PANDE and T. S. SRIVASTAVA, Lucknow.

A direct complexometric titration of iron (III) with EDTA using o-cresotic acid as a metal indicator is given. The colour change of the indicator is from blue-violet to light yellow or colourless. The optimum temperature and pH range is 35° to 55°C and 2.2 to 4.2 respectively. Macro and microgram quantities of iron (III) are accurately estimated with the help of this indicator. Iron (III) may easily be titrated in the presence of various metallic ions e.g. Be (II), Mg (II), Ca (II), Sr (II), Ba (II), Cd (II), UO_2 (II) and Mn (II) without any interference in the estimation.

299. Radio-Chromatography of alkali earth ions Part II Variation of R_f values of Sr^{++} and Y^{+++} with the amount of Ba^{++} .

H. J. ARNIKAR and J. P. TANDON, Varanasi.

The technique of Radio Chromatography on acid washed asbestos paper employed earlier by one of us (H.J.A.) for separation of alkali and alkali-earth ions is now used for the study of the capacity of the asbestos paper considered as iron exchanger in the separation of Ba^{++} , Sr^{++} and Y^{+++} ions using Ba^{133} , Sr^{90} and Y^{90} as Radio tracers. The shift in the R_f values of Sr^{++} and Y^{+++} due to a progressive increase of Ba^{++} is studied until the separation becomes difficult. From these results the approximate ion exchange capacity of the asbestos paper is computed for this separation,

300. Analytical Application of Embelin Part I. Estimation of Uranium.

V. VENKATESWARLU, Waltair.

In pure solutions, uranium could be estimated on a semi-micro scale using embelin as a precipitant. With embelin, uranium solutions at pH 6.0–6.5 give bluish pink tinted complexes, soluble in alcohol, whose composition is somewhat variable but determinable as U_3O_8 by direct ignition.

301. Paper chromatographic identification of ascorbigen in plant materials.

SHAKUNTALA BOSE and B. C. GUHA, Calcutta.

Experiments have been carried out with different solvent mixtures for the separation of ascorbigen (bound ascorbic acid) in plant materials by paper chromatography. Special reagents for its identification have also been used. Ethyl-acetate chloroform mixture (4:2) and methanol *n*-butanol (4:2) were found to be the most suitable solvent mixtures for the purpose. Ehrlich's reagent, formal plus HCl and 2:6-dichlorophenol-indophenol were very suitable reagents for the identification of ascorbigen.

302. Analytical Application of Embelin Part II. Estimation of Thorium.

V. VENKATESWARLU, Waltair.

Using embelin, thorium in acid solutions of 0.4 N HCl, is precipitated quantitatively as an insoluble violet complex of slightly variable composition which could be directly determined by ignition as thoria. In these estimations, rare earths and other metallic ions, Cu, Cd, Ca, Ba, Zn, Mg, Al and U do not interfere as their complexes are unstable in such acid concentrations. The estimation could easily be carried out with accuracy, on a semi-micro scale.

303. Titrimetric Determination of Manganese and its Separation from Iron using Pyridine and Thiocyanate.

K. S. BHATKI and A. T. RANI, Bombay.

The most accurate determination of manganese is accomplished by precipitating it from a known aliquot of the manganese solution with pyridine and an excess of standard thiocyanate solution in a standard measuring flask. The flask is then shaken for some time for complete precipitation of manganese-pyridine-thiocyanate complex and the solution filtered. Measured aliquot of the filtrate, after acidifying with nitric acid, is treated with an excess of standard silver nitrate solution and the excess back titrated with standard thiocyanate solution using ferric alum as the indicator.

In the separation of manganese from iron, the latter is quantitatively precipitated as hydroxide by acidifying the aliquot containing the mixture with nitric acid and then treating with slight excess of pyridine. After the removal of precipitated iron by filtration, the manganese in the filtrate is estimated volumetrically as described above. Quantitative results are obtained by double precipitation.

304. Photolytic separation of Uranium from Vanadium.

I. B. MISHRA, B. SAHOO and D. PATNAIK, Cuttack.

The separation of uranium from vanadium has been accomplished by photochemical method. Sunlight has been used as the source of energy for the photolysis.

Uranium is precipitated as the hydrated uranium (IV) oxysulphate leaving vanadium in solution, when a mixture of the solutions of the sulphates of uranium and vanadium is photolysed in presence of alcohol and formic acid, the pH being maintained between 2.1 to 2.3. By this process at least 99.9% pure uranium is obtained. If vanadium is at all present, it is in traces, which has been analysed by colorimetry. Recovery of uranium is dependent on the percentage composition of alcohol. No loss of uranium occurs, as the solution containing the remaining quantity of uranium which is not precipitated can be used again.

305. Resolution of Fatty Acid Mixtures by Paper Chromatography : Separation of Coconut Oil Acids.

(Miss) PUSPA BHATTACHARJEE and M. M. CHAKRABARTY, Calcutta.

Studies have been made on the application of paper chromatography for the analysis of mixed fatty acids of coconut oil. The R_F values were first of all established with samples of pure fatty acids and the mixed fatty acids were then tested under the same condition. Good separation of the fatty acids were obtainable with fair agreement between the R_F values of individual fatty acids and those separated from the mixtures. For the chromatograms Whatman No. 3 paper strips were impregnated with Liquid paraffin in petrol ether solution (5% W/V). The fatty acids were dissolved in alcohol (5% W/V) and applied to the paper and later eluted with 93% aqueous acetic acid. Detection of spots were done with the help of cupric acetate followed by Potassium ferrocyanide or Dithio-oxamide to get brown and dark green spots respectively.

306. Studies in Adsorption Indicators—I. Phthalein dyes in Argentometric Titrations.

(Miss) UMA KAPOOR and H. L. NIGAM, Allahabad.

Suitability of a number of new phthalein dyes as adsorption indicators in argentometric titrations of halide and sulphocyanide ions has been studied; changes have been made in phthalic acid part of the dye in one hand and the condensing aromatic alcohol on the other hand. In one series, dyes of the type Resorcinol- Δ 2-tetrahydrophthalein, Res Δ 2:6-dihydrophthalein, Resorcinol Δ 3:5-dihydrophthalein, Resorcinol-3:6 diphenyl Δ 4-tetrahydrophthalic acid, and in the other series Resorcinol Δ 2-tetrahydrophthalein, Orcinol Δ 2-tetrahydrophthalein, phloroglucinol Δ 2-tetrahydrophthalein have been studied. Adsorbability of the series of the dyes does not follow the expected order; the result appears to lend more weight to the view of silver complex formation, rather than the secondary adsorption or silver salt formation in the theory of adsorption indicators.

Detailed experimental procedure have been described for Resorcinol Δ 2-tetrahydrophthalein and Resorcinol Δ 2:6-dihydrophthalein, which are comparable to fluorescein.

307. The Estimation of Iron (III) by Iodometry.

A. CHIRANJEVI and D. PATNAIK, Cuttack.

The role of various factors which affect the Iodometric method of estimating Iron (III) viz., use of Copper as a catalyst, Hydrogen ion concentration, concentration of iodide ion, photodecomposition of hydroiodic acid, effect of anion like sulphate, maintenance of Carbon dioxide atmosphere and the time of rest required for liberation of Iodine has been investigated. It has been found that the sequence of addition of cuprous iodide and potassium iodide has got an effect on after-bluing. If cuprous iodide at all is to be used it should follow the addition of potassium iodide. The optimum hydrogen ion concentration has been found to be 0.5 N. The use of 3.5-4.0 gms. of solid potassium iodide for 25 cc. of N/10 ferric salt solution requires only 3 minutes for liberation of iodine. This short duration of time does not necessitate the use of carbon dioxide atmosphere and renders the photochemical decomposition of hydrogen iodide negligible. The iodometric method becomes as accurate as any other standard laboratory method with the above specifications.

308. Estimation of Thorium with 3, 4-Dihydroxy Benzoic Acid.

GIRISH R. AMLADI and Y. V. LAWANDI, Bombay.

3, 4-Dihydroxy benzoic acid, or protocatechuic acid has been investigated as a quantitative precipitating reagent for thorium. In the presence of ammonium hydroxide, the reagent quantitatively precipitates thorium from its nitrate solution. Separation of thorium from artificial mixtures of nitrates of thorium, cerium and lanthanum and also from monazite sands, has been carried out with a pH range of 3 to 5.

309. Anion Exchange Studies of Uranium.

S. M. KHOPKAR and ANIL K. DE, Calcutta.

At pH 1.0-1.5 uranium forms an anionic complex in sulphate solutions, which can be sorbed on an anion exchanger like Dowex 21 K. Systematic and critical studies have been undertaken on the anion exchange behaviour of uranium, employing Dowex 21 K(SO₄-form). The concentration of uranium studied is in the milligram level. For quantitative elution of the uranium adsorbed on the resin bed, eluting agents like HClO₄, HNO₃, H₂SO₄, HCl (1-2 M each) and also NH₄Cl, NaNO₃ may be employed. Acetates, citrates and tartrates are poor eluting agents. From the effluent lot (200 ml.) in each case the uranium is estimated gravimetrically as oxinate, after destroying any organic matter from the resin bed by evaporation with sulphuric and perchloric acids. This evaporation step is avoided in case of the sodium and ammonium salts as eluting agents. Uranium may be separated from many mixtures by this method.

310. Thenoyltrifluoroacetone as a chelating and colorimetric reagent.

S. M. KHOPKAR and ANIL K. DE, Calcutta.

The chelating agent, thenoyltrifluoroacetone (TTA) (in benzene solution) gives colour reactions with UO₂²⁺, Cu²⁺, CO²⁺, Ni²⁺, Mn²⁺, Fe³⁺, Cr³⁺ and Ce⁴⁺. In most of the cases brightly coloured solutions result, which can be used for spectrophotometric studies. Thus spectrophotometric methods have been developed for

milligram amounts of Cu^{2+} , Fe^{3+} and UO_2^{2+} . The TTA-chelates are rapidly extracted in quantitative amounts by benzene at suitable pH and the organic phases directly measured. This provides the basis for simultaneous extraction and spectrophotometric determination of Cu^{2+} , Fe^{3+} and UO_2^{2+} at milligram level, requiring only 15-20 minutes for each run. The methods are accurate and reproducible to within $\pm 2\%$.

311. Analytical Reactions of some Azo Dyes from Chromotropic Acid and Sulfonamides.

SACHINDRA KUMAR DATTA and SACHINDRA NATH SAHA, Coochbehar.

Diazotised sulfonamides are found to couple with chromotropic acid in alkaline medium forming azo dyes having pink to red colour. Six azo dyes have been prepared in this way from sulfanilamide, sulfapyridine, sulfadiazine, sulfaguanidine, sulfamerazine and sulfathiazole. The dyes present special interest in the colour reactions of metals like other dyes of chromotropic acid investigated before. Analytical behaviour of all these dyes have been studied in this paper. All the dyes exhibit colour reaction with thorium and some could be successfully employed in spot test reactions, as indicators in volumetric and complexometric titrations and in the photometric determination of thorium. Most of the dyes show colour changes with zirconium, cerium and lanthanum also, almost under similar conditions, and react with metals like cobalt, nickel, beryllium, aluminium, manganese and magnesium showing colour changes. They may also find use as chromogenic spray in the paper chromatographic analysis. Spot test reactions for thorium have been carried out to detect thorium up to a limit of 1.16 microgram.

312. Studies in Adsorption Indicator : Part I. Butyl Sulphonphthalein as Adsorption Indicator in Argentometric Titrations.

A. B. SEN and (Miss) S. MISRA, Lucknow.

Butyl sulphonphthalein has been used as adsorption indicator in argentometric titrations and has been found to be more sensitive than fluorescein under certain conditions.

313. Gravimetric Estimation of Zirconium—Part II.

A. B. SEN and (Miss) S. MISRA, Lucknow.

In continuation of our work on this subject, we have now prepared *m*-methoxy phenoxy acetic acid according to the method of Mays and Branch and used it for the estimation of Zirconium. It was found to be more sensitive than *m*-methyl phenoxy acetic acid reported earlier.

314. Estimation of Beryllium by Ferrocyanide.

(Miss) K. ZUTSHI, Jaipur.

In the studies on the composition of metallic ferrocyanides by physico-chemical methods by Gaur and Bhattacharya, it was established that the formation of different complexes depends upon the various factors like concentration of the reactants, upon the presence of the non-interfering electrolytes and also upon the pH of the solution.

Precipitation of $\text{Be}_2\text{Fe}(\text{CN})_6$ from a solution of beryllium nitrate with potassium ferrocyanide at various concentrations has been carried out at 80°C . The precipitate was filtered and the excess of ferrocyanide thus obtained was titrated against a standard solution of potassium permanganate. The amount of potassium ferrocyanide that reacted with beryllium nitrate to form beryllium ferrocyanide was calculated. From the titration relationship in all cases, the precipitate bears the composition $\text{Be}_2\text{Fe}(\text{CN})_6$. This provides a correct and easier method for the estimation of beryllium volumetrically.

315. A Three-component Solvent System for Separation of Amino Acids by Circular Paper Chromatography.

LOURDU M. YEDDANAPALLI and A. SRINIVASAN, Madras.

A three-component homogeneous solvent system of n-butanol-water-acetic acid has been worked out for the effective separation of amino acids by circular paper chromatography. It is made up of n-butanol-water-acetic acid in the ratio, by volume, 4:1:0.2 and can separate lysine, histidine, glutamic acid, threonine, leucines and phenyl alanine by single radial development in ten hours.

This particular solvent ratio has the advantage over the usually employed ratio of 4:5:1, in that no equilibration of chromatographic chamber and paper is necessary. Also there is effective separation of the above-mentioned amino acids even by a single development, resulting in well-defined, sharp and clear bands, which can be estimated quantitatively.

316. Studies in the Cation Exchange of various Cellulosate : Part I—Calcium Cellulosate.

C. J. SHAHANI and C. S. NARWANI, Bombay.

Samples of Calcium Cellulosate prepared by the interaction of Calcium Acetate with Oxy-cellulose, containing $-\text{COOH}$ groups varying from 33 to 277 milliequivalents per 100 gms., obtained by oxidising filter paper pulp with (a) alkaline NaOBr at pH 13.0, (b) NO_2 , (c) a mixture of sulphuric and nitric acids (10:90) at room temperature, have been used for the exchange Na^+ and K^+ ions from the aqueous solutions of their halides at different concentrations, by both the batch and the column operations.

The cationic exchange ability of Ca-cellulosate has been compared with that of Oxy-cellulose and has been found to be nearly three times that of the latter.

The ionic exchange of H^+ and C^{++} ions by Na^+ or K^+ ions respectively has been used for estimating the latter in N/20 and N/50 solutions; the breakthrough point in both the cases has been determined by column operation.

317. Colorimetric Micro-determination of Cyanide and Thiocyanate.

G. S. DESHMUKH and S. V. TALWAWADI, Varanasi.

It was previously observed that cyanide and/or thiocyanate develop a deep yellow colour with pyridine and hypobromite. Further investigations showed that chloramine-T, due to its greater stability and similar chemical character, can be used as a substitute for hypobromite. Study of the optimum concentrations of pyridine and chloramine-T for a given quantity of cyanide and thiocyanate, the pH of the reaction and its mechanism, time of standing and interference due to a number of commonly occurring cations and anions has now been carried out.

A Hilger Spekker Absorptiometer unit H 760 and a violet filter having maximum transmission at $430\text{ m}\mu$ were used. Micro-quantities of both cyanide and thiocyanate were determined by this method with an accuracy comparable with that of the other classical methods.

318. Separation of Titanium from Iron by Ion Exchange.

S. P. GHOSH and A. P. SHRIVASTAVA, Patna.

A method is proposed for separation of Titanium from Iron by preferentially adsorbing Iron in strong HCl in exchange Resin IRA-400 after converting it to the citrate form.

319. Studies on the Recovery of Uranium from Fluoride Solutions by Anion Exchange.

V. S. SASTRY and T. R. BHAT, Bombay.

A detailed study of the recovery of uranium from fluoride solutions by anion exchange is given. The saturation capacity was found to increase slightly with pH to a value of about $0.8\text{ gm. U}_3\text{O}_8/\text{gm.}$ of the resin. The adsorption characteristics under different conditions, such as the addition of different amounts of fluoride, sulphate, chloride and at different flow-rates, were determined. The break-through as well as the saturation capacities for uranium were reduced by the addition of SO_4^{2-} and Cl^- .

Elution characteristics were studied using a mixture of sodium nitrate and nitric acid and a mixture of NaCl and HCl. For practical purposes a mixture of $0.3\text{M HNO}_3 + 0.7\text{M NaNO}_3$ or $0.3\text{M HCl} + 0.7\text{M NaCl}$ was found to be suitable as eluants.

320. Separation and identification of dicarboxylic acids by paper chromatography.

S. C. SEN GUPTA, Ranchi.

To identify by paper chromatography the dicarboxylic acid obtained from the degradative studies of butolic acid (mp. $54-55^\circ\text{C}$), a minor constituent acid of shellac, work was undertaken with the known dicarboxylic acids e.g., malonic, succinic, glutaric, adipic, pimelic, suberic, azelaic and sebacic acids. Solvent systems tried were (i) butanol-formic acid-water, (ii) butanol-acetic acid-water, (iii) aqueous ethyl alcohol-ammonia, (iv) butanol saturated with 2N ammonia and (v) *iso*-butanol saturated with 2N ammonia. In the last two solvents suberic, azelaic and sebacic acids moved up only to a little distance. The remaining solvents gave good separation. In case of aqueous ethyl alcohol-ammonia, the R_f values could be altered considerably varying the proportion of water. The R_f values of the acids in the solvent ethyl alcohol (80%) liquor ammonia (100%) were 0.19, 0.31, 0.36, 0.42, 0.47, 0.52, 0.55 and 0.58 respectively. The dicarboxylic acid from degraded butolic acid was identified to be adipic acid.

321. Spectrophotometric Determination of Platinum : Part I. Anthranilic Acid as a Reagent.

A. K. MAJUMDAR and J. G. SEN GUPTA, Calcutta.

Anthranilic acid when heated on the steam bath with chloroplatinic acid at pH 5.0 gives a reddish violet complex having absorption maximum at $500\text{ m}\mu$. The

violet coloured system obeys Beer's law from 4 to 64 p.p.m. of platinum (IV) with an optimum concentration range of 16 to 48 p.p.m. where the per cent relative error per 1% absolute photometric error is 2.87.

Composition study by three techniques suggest the formation by platinum (IV) of a 1 : 1 complex with the reagent, and the dissociation constant of the complex is 2.6×10^{-4} only when measured at 28°C

322. Spectrophotometric Determination of Ruthenium : Part I. Anthranilic Acid as a Reagent.

A. K. MAJUMDAR and J. G. SEN GUPTA, Calcutta.

A new method for the spectrophotometric determination of ruthenium with anthranilic acid has been described. The reagent, at pH range 5.2–6, forms with ruthenium (III) a green complex having absorption maximum at 620 m μ . The colour system obeys Beer's law for 1 to 20 p.p.m. with an optimum concentration range of 4 to 16 p.p.m. where the % relative error per 1% absolute photometric error is 3.2.

Job and molar ratio methods indicate the formation of a 1 : 2 complex between ruthenium (III) and the reagent and the average dissociation constant of the complex is 1.74×10^{-8} at 24°C.

323. Spectrophotometric Determination of Ruthenium : Part II. O-amino-phenol-p-Sulphonic acid as a reagent.

A. K. MAJUMDAR and J. G. SEN GUPTA, Calcutta.

O-amino-phenol-p-sulphonic acid has been used as a spectrophotometric reagent for ruthenium. At the pH range of 4 to 6 it forms a red coloured complex with a sharp absorption maximum at 560 m μ and a broad band of slightly lower absorbance centering at about 440 m μ . Beer's law is not obeyed but absorbance concentration plots follow linearity from 4 to 32 p.p.m. of ruthenium. The optimum concentration range is, however, between 8 and 24 p.p.m., where the % relative errors per 1% absolute photometric error are 3.7 and 4.2 at the wave lengths of 440 m μ and 560 m μ , respectively.

Job and molar ratio methods indicate that ruthenium (III) reacts with the reagent in the ratio of 2 : 1.

324. Spectrophotometric Determination of Osmium. Part III. O-aminophenol-p-sulphonic acid as a reagent.

A. K. MAJUMDAR and J. G. SEN GUPTA, Calcutta.

O-aminophenol-p-sulphonic acid has been found to be a very sensitive reagent for spectrophotometric determination of octavalent and hexavalent osmium at the pH range 2.5–4. The colour system with absorption maximum at 440 m μ obeys Beer's law with 1 to 10 p.p.m. of osmium and the optimum concentration range is from 2 to 8 p.p.m. of osmium. In the latter range the per cent relative error per 1% absolute photometric error is 2.98 for osmium (VIII). Moderate amounts of Pd⁺, Ir⁺, WO₄⁻², Cr⁺, Zn⁺, Zr⁺, Mg⁺, Ba⁺ and Sr⁺ do not interfere with the determination.

Continuous variation, molar ratio and slope ratio methods indicate the formation of a 1 : 2 complex between the hexavalent metal and the reagent. Molar ratio method shows further that osmium tetroxide first oxidizes the reagent and then in

the reduced state combines with it to form the same 1 : 2 complex; average dissociation constant of the complex being 1.2×10^{-7} at 34°C.

325. Spectrophotometric Determination of Osmium. Part IV. 1-amino-8-naphthol-3:6-disulphonic acid as a reagent.

A. K. MAJUMDAR and J. G. SEN GUPTA, Calcutta.

1-amino-8-naphthol-3 : 6-disulphonic acid has been employed as a sensitive spectrophotometric reagent for osmium (VI) and osmium (VIII) at the pH range 4.5 to 6. The element in both these valence states forms a brownish-black complex having the absorption maximum at 480 m μ . Beer's law is obeyed for 1 to 10 p.p.m. of osmium with the optimum concentration range from 2 to 8 p.p.m., where the % relative error per 1% absolute photometric error is 2.93 for osmium (VIII). Moderate amounts of ions such as Pd²⁺, Pt⁴⁺, Hg²⁺, WO₄²⁻, UO₂²⁺, Al³⁺, Co²⁺, Ni²⁺, Mg²⁺, Ca²⁺, Ba²⁺, Sr²⁺, Cd²⁺, Zr⁴⁺ and Zn²⁺ do not interfere in the determination. Ions such as Ru³⁺, Rh³⁺, Ir⁴⁺, Cu²⁺, As³⁺, Bi³⁺, Mn²⁺, Cr³⁺, Fe³⁺, and Th⁴⁺ interfere.

326. Spectrophotometric Determination of Osmium : Part V. m-amino benzoic acid as a reagent.

A. K. MAJUMDAR and J. G. SEN GUPTA, Calcutta.

m-amino benzoic acid in large excess reacts with tetra-, hexa- and octavalent osmium at the pH range 4.5–6 to give a purple complex having absorption maximum at 500 m μ . Beer's law is obeyed for 0.5 to 8 p.p.m. of osmium (VI) and osmium (VIII) with optimum concentration range of 3 to 8 p.p.m. for osmium (VIII). The % relative error per 1% absolute photometric error is 2.8 for both osmium (VI) and osmium (VIII). Ions such as Pd²⁺, Rh³⁺, Ir⁴⁺, W⁶⁺, U⁶⁺, Co²⁺, Hg²⁺, Mg²⁺, Ca²⁺, Ba²⁺, Sr²⁺, Th⁴⁺ and Zr⁴⁺ do not interfere in the determination.

Molar ratio method indicates that the reagent first reduces osmium (VIII) and osmium (VI) to osmium (IV), which then probably forms a 1 : 1 complex with the excess unoxidised reagent.

327. Spectrophotometric Determination of Titanium with 9-methyl-2:3:7-trihydroxy-6-fluorone.

A. K. MAJUMDAR and C. P. SAVARIAR, Calcutta.

9-methyl-2 : 3 : 7-trihydroxy-6-fluorone is described as a highly sensitive reagent for its reaction with titanium. The rose-red complex gives maximum absorption at 520 m μ and obeys Beer's law from 0.025 to 0.6 p.p.m. of titanium. The optimum concentration range is from 0.1 to 0.6 p.p.m. of titanium, where the relative analysis error is 3.1%. The composition of the complex in solution as evaluated by continuous variation and molar ratio methods gives a metal to reagent ratio of 1 : 2. The molar extinction coefficient and the instability constant of the complex are about 60360 and 1.6×10^{-12} as determined at 20°C.

328. Spectrophotometric Determination of Molybdenum with 9-methyl-2:3:7-trihydroxy-6-fluorone.

A. K. MAJUMDAR and C. P. SAVARIAR, Calcutta.

9-methyl-2 : 3 : 7-trihydroxy-6-fluorone is presented as a new and highly sensitive reagent for its colour reactions with molybdenum. The rose-red complex shows

maximum absorption at $510\text{ m}\mu$ and obeys Beer's law from 0.2 to 3 p.p.m. of molybdenum, where the per cent relative analysis error is only 2.8. The optimum concentration range is from 0.8 to 3 p.p.m. of molybdenum. The composition of the complex, as evaluated by Job's method and as verified by molar ratio method, indicates that in solution the complex contains molybdenum and the reagent in a ratio of 1:1. The instability constant of the complex is about 2.09×10^{-6} at 20°C .

329. Spectrophotometric studies on the nature of Iron complexes with Pyridine and Quinoline carboxylic acids.

A. K. MAJUMDAR and S. P. BAG, Calcutta.

The composition of the ferrous iron complexes with α -picolinic, quinaldinic and quinolinic acids have been investigated. In presence of potassium cyanide, the metal ion in solution combines with the reagents in a ratio of 1:1; while at a pH of 5.9, in the absence of potassium cyanide, the metal to reagent ratio is 1:2 in all cases. The instability constants of 1:1 complexes are of the order of 2.5×10^{-5} for picolinic acid, 7.51×10^{-6} for quinaldinic acid and 2.73×10^{-5} for quinolinic acid, while those for 1:2 complexes are 1.53×10^{-8} , 2.02×10^{-8} and 1.72×10^{-9} respectively.

330. Paper Chromatography in Separation of Inorganic Ions. Separation of Alkali and Alkaline earth metals.

A. K. MAJUMDAR and BIJOLI K. PAL, Calcutta.

A study has been made of the separation of alkali and alkaline earth metals with mixtures of solvents, such as ethyl cellosolve, hydrochloric acid and water, and acetone, hydrochloric acid and water in the ratio of 70:10:20 at different temperatures. The effective separation of alkaline earth metals was obtained from each other. In the case of alkali metals, lithium, sodium, and potassium were separated but rubidium and caesium accompanied potassium.

331. Micro-chemical Determination of Iodine in Foodstuffs, Soil and Water.

P. N. SEN GUPTA, Calcutta.

Endemic goiter is prevalent in the entire regions of North-Eastern Himalayas. A systematic investigation was undertaken among the tribes living there to assess whether there was deficiency of iodine in foodstuffs, drinking water and soil of agricultural fields or goitrogenic substances were being ingested through vegetables to render iodine unavailable to the thyroid gland. About 100 samples of these materials were collected from different villages in the lower and higher regions of the hills and iodine contents were determined in these. The existing methods were not found to give comparable results in many cases, improved micro techniques were therefore developed by the author for determination of iodine in the samples as well as in iodized salt used for prevention of goiter. The techniques were based on digestion with alkali, slowly heating the dried mass for 2 hours at 150°C to 450°C in muffle furnace without smoking, extracting with 95% alcohol, evaporating alcohol to dryness and taking the residue in 5 c.c. water. Iodine was liberated after oxidation, extracted with 5 c.c. chloroform and the colour was matched with similarly treated standard in a photo-electric colorimeter. The results of 60 samples of cereals, vegetables, fish, water and soil have been tabulated.

332. Estimation of Acrylic Esters with Mercuric Acetate by non-aqueous titration.

KANAI LAL MALIK, Calcutta.

The addition of mercuric acetate to acrylic esters in methanol is very strongly accelerated by catalytic amounts of a strong acid like perchloric or nitric acid. Quantitative addition occurs in less than 40 minutes at 45°C and this offers a simple method for rapid estimation of acrylates. (Methacrylates were similarly estimated by the author as reported in Chem. and Ind., 162, 1959). The results indicate that the method yields very good results for analysis of acrylate and methacrylate esters. The method also affords a rapid and simple means for accurate determination of these monomers.

333. Ion Exchange Separation of Titanium from Steels and its Determination with Hydrogen Peroxide.

M. N. NADKARNI and VENKATESWARLU CH., Bombay.

Titanium is separated from its associates in steels as the fluoride complex on an anion exchanger in 0.1 M hydrochloric acid and 0.4 M hydrofluoric acid. After elution with 3 M hydrochloric acid, it is estimated with the usual peroxide method.

334. Spectrophotometric Determination of Niobium and Tantalum in the Presence of each other using Gallic Acid and Ethylenediaminetetraacetic Acid.

MADHAVA MINON V. P., SRINIVASALU K. and VENKATESWARLU CH., Bombay.

The gallic acid complexes of niobium and tantalum are studied spectrophotometrically in the presence and absence of ethylenediaminetetraacetic acid. Different procedures are described for the determinations of one in the presence of the other without interference.

335. Radiometric estimation of traces of Zirconium.

K. R. KAR and B. C. SAWHNEY, Delhi.

A radiometric method for the estimation of traces of Zirconium ($\sim 2\mu\text{g}$) has been developed. The method in outline involves a radiometric estimation of the quantity of phosphorous removed, from a standard pyrophosphate solution (tagged with P_{32}) by the unknown sample of Zirconium, as the insoluble ZrP_2O_7 . Knowing the specific activity of the precipitant pyrophosphate solution before and after precipitation, amount of separated phosphorus, and hence the amount of unknown Zirconium is determined. Silver Iodide (produced in situ) in dilute nitric acid (0.4N) and containing excess of the corresponding anion, has been used as collector for the Zirconium pyrophosphate. The estimation can be completed within an hour and a half with an accuracy of $\pm 1.0\%$. The same method has been extended for Zirconium estimation in presence of the interfering metals Cerium (IV) and Lanthanum. For this purpose Silver thiocyanate instead of AgI has been used as the carrier. In order to avoid interference by quadri-valent Cerium, latter is reduced by a little hydrogen peroxide before precipitation. The same degree of accuracy and efficiency has been achieved in this case also.

336. The Estimation of Nitrite in Mercurous Nitrite.

T. M. OZA and B. A. V. MIRZA, Bombay.

Measurement of Dumas nitrogen does not detect nitrate in small amounts. Nitrometer gives two to three per cent negative error presumably because of the solubility of nitric oxide. Permanganate method cannot be applied directly as mercurous is also oxidized. Aqueous extract contains, on the other hand, nitrate formed by hydrolysis of the nitrite which gives nitrous acid in water.

Extraction with alkali was reported by P. C. Ray not to yield correct results with mercurous nitrite. It is found that this is so only if concentrated solutions of alkali are used. With alkali of 1 to 2 percent strength extraction of nitrite is complete and nitrite can be estimated in the alkali extract by the permanganate method.

337. Colorimetric Micro-determination of Gold with Thiocyanate.

G. S. DESHMUKH and S. V. TATWAWADI, Varanasi.

The negative interference of copper and silver and the positive interference of gold in the thiocyanate-pyridinechloramine T reaction was utilised for the micro-determination of these metal ions. It was observed that under the experimental conditions, gold intensified the yellow colour developed in the above reaction. Less than 1 p.p.m. of gold was determined by this method. The study of the mechanism of this reaction and the optimum conditions for the development of the colour is in progress.

BIOCHEMISTRY**338. Component Acids of Indian Fresh-water Fish (*Eutropiichthys vacha*) Body Fat.**

S. P. PATHAK and A. K. VASISHTHA, Varanasi-5.

The component acids of vacha body fat (sp. gr., 0.96; Ref. index., 1.47; A. V., 5.8; I.V., 98.3; S.V., 198.0; S.E., 283.3; R.P.V., 0.5 and R.P.V., 2.5) were determined by usual fractional crystallization and ester fractionation methods. The component fatty acids are Myristic, 2.9%; Palmitic, 24.6%; Stearic, 7.4% and Arachidic, 0.3% among the saturated acids. The unsaturated acids comprise C_{14} , 0.6%; C_{16} , 17.8%; C_{18} , 33.4%; C_{20} , 10.4%; and C_{22} , 2.6% with the mean unsaturation as: -2.0, -2.0, -3.2, -6.0 and -8.0 respectively.

This study confirms that predominance of C_{18} unsaturated acid is the characteristic of fresh-water fish fats. Vacha body fat, when compared with the fats of marine origin, distinguishes itself in its much lower content of C_{20-22} unsaturated acids and thus supports the view that fresh water fishes and marine fishes are of the two distinct types. Higher percentage of saturated acids in the fat shows the tendency of biohydrogenation in the body fats of tropical fresh-water fishes which leads to a partial saturation of unsaturated component acids.

339. Search for Antifilarials.

D. MISHRA, Cuttack.

Numerous drugs have been tried in the treatment of filariasis. Antifilarials are drugs which can reduce the number of microfilarial in the peripheral circulation or

kill the adult worms of the nematodes. The antimonials and arsenicals have not proved effective in all types of human infection except destroying some adult worms. Only a few piperazine derivatives have been found to be more effective but adult worms are not affected by them. In the light of the present knowledge of structure-activity-relationship of filaricidal compounds, planned synthesis of new organic compounds with theoretical possibility of existing antifilaricidal activity are being made. These Non-metallic compounds exhibiting useful pharmacological and chemotherapeutic action will be studied in detail including acute and chronic toxicity studies on various species of laboratory animals.

340. Immunological Techniques in Pursuit of Etiology of Cataracts.

S. N. COOPER, MRS. KUSUM PADUKONE and Miss PRAMODE BHATIA,
Bombay.

The hemagglutination tests have proved :—

- (1) The presence of minute quantities of antibodies to lens proteins in the blood of normal animals.
- (2) Absence of lens antibodies in the aqueous and vitreous of normal animals.
- (3) Presence of lens antibodies in the aqueous and vitreous of animals sensitized to lens proteins.

The gel diffusion technique has proved that lens proteins leak out into the aqueous and vitreous, but cannot be demonstrated in blood.

A peculiar situation thus arises.

Explanation: Lens proteins leak out in the aqueous and vitreous and then into circulation. Antibodies are thus formed and neutralize the lens antigen entering the blood. Thus antibodies can be found in the blood but not the lens proteins.

Secondly, lens antibodies which enter the aqueous and vitreous of normal animals get precipitated by the lens proteins escaping into the aqueous and vitreous, and can only be demonstrated if produced in excess as after sensitization to lens proteins.

Thus in sensitized animals there is a risk of cataract formation if excess antibodies enter the lens capsule.

Five possible lines of defence against cataract formation are discussed and cataract in animals can be produced only by breaking all these lines.

341. Activity of Yeast Invertase after repeated Chromatographic Treatments.

M. M. BISWAS, Calcutta.

An yeast extract was prepared by autolysing a previously dialysed sample of brewer's yeast with distilled water and toluol and then filtering with kieselguhr under suction. Filtrate was vacuum dried. A 2% solution of this product was used in the chromatographic processes. At the first stage invertase solution was filtered through a mixture of 3 parts Brockmann's alumina and 1 part quartz powder in a 10 cm. × 2 cm. chromatographic tube. Adsorbed enzymes from the column were

eluted with $\frac{N}{10}$ ammonia. Ratio of invertase activities of both the filtrate and eluate was determined. The filtrate of first stage was then chromatographically treated and ratio of invertase activities of filtrate and eluate was determined. Filtrate of this second stage was treated in the same way and activity ratio determined at the third stage. Ratio of invertase activities of filtrate and eluate at the first stage was found to be 1.53 indicating that separation of invertase has taken place in the filtrate. The activity ratios are practically constant at the second and third stages viz., 1.20 and 1.26 which indicates that maximum purification of invertase is attained at the third stage.

342. Two broad spectrum antibiotics isolated from two *Streptomyces* spp.

RABINDRA KR. SINHA, PRINTINDRA MOHAN NAHA and P. NANDI, Calcutta.

Of large number of isolated *Streptomyces* sp., broad-spectrum antibiotic producing strains—Ac₁₄475 and Ac₁₃L₇ were selected for detailed study. The active substances were purified using ion-exchange resin IRC-50 and alumina as absorbents.

Strain Ac₁₄ 475—The metabolic filtrate was passed through IRC-50 resin column and elution was done with N/20 methanolic HCl. This was evaporated and to the residue fresh methanol was added. The methanolic ext. was then passed through column of alumina and eluted again with methanol and acetone. The active substance was finally precipitated by the addition of excess of ether to the elute.

Strain Ac₁₃ L₇—The active substance is weakly basic and was isolated as a sulphate derivative. Here also the broth was passed through ion-exchange resin IRC-50, eluted with N/50 HCl and (N) H₂SO₄ was added. The active material separates out by the addition of 95% ethyl alcohol in the ratio 1 : 1 to the eluate.

343. Effect of Biotin Deficiency on Ammonia Metabolism in Rat Brain.

BAIDYA NATH GHOSH and J. J. GHOSH, Calcutta.

The mechanism by which glucose suppresses the endogenous ammonia formation in brain is not clear. It has been suggested that glucose may act either by inhibiting the ammonia forming mechanism or by accelerating the ammonia removal mechanism. In biotin deficient rat brain, it has been found that although the endogenous ammonia level is higher than normal, the rate of formation of ammonia is not very different from that of normal. The ammonia suppressing effect of glucose, which is very prominent in normal brain homogenate, is completely absent in biotin-deficient rat brain homogenate. It seems that biotin may be directly or indirectly involved in the ammonia metabolism in brain. Further details regarding the effect of biotin deficiency on ammonia forming and ammonia removal mechanism in rat brain will be discussed.

344. Stability of RNA synthesized by *E. coli* B cells in presence of Chloramphenicol.

R. K. DUTTA, (Miss) ARATI RUDRA, (Miss) ROMA GANGULY and J. J. GHOSH, Calcutta.

It has already been reported from this laboratory that stimulation in the synthesis of intracellular RNA in Chloramphenicol (CP) treated *E. coli* cells was more marked at lower concentrations of CP than at higher concentrations. Upon removal of CP, when the cultures were transferred to normal saline, it was found that most of the intracellular RNA was unstable and ejected in the saline medium in the form of free purine and pyrimidine bases, of which hypoxanthine and uracil were the major constituents.

The stability of the CP-induced RNA has been found to be dependent on the concentration of CP used either in the growing or resting medium. The higher the concentration of CP used, the more is the unstable nature of RNA, as revealed by rapid excretion of the nucleic acid bases. Additions of either glucose as carbon source or ammonium sulphate as nitrogen source to normal saline (in isotonic condition) help to stabilize the RNA as revealed by the less excretion of the nucleic acid bases. Addition of either phosphate or pyrophosphate in the saline media, makes the RNA more unstable as reflected by the excess excretion of purine and pyrimidine bases. CP appears to activate some of the RNA depolymerizing enzymes

and other nucleolytic enzymes in course of its action on *E. coli* cells. Further details on this observation will be discussed.

345. Effect of Vitamin B₁₂ on Some Liver Enzymes During the Development of Fatty livers in young Albino Rats.

S. G. JOSHI, P. J. MODI and R. G. CHITRE, Bombay.

The experiments conducted in this laboratory earlier indicated that the fatty change developing in livers of young albino rats maintained on high fat, low protein choline and vitamin B₁₂ deficient diet is localised in the periportal zone in the initial stage. Vitamin B₁₂ was found to be protective against the development of such fatty livers. The nature of fatty metamorphosis suggested that vitamin B₁₂ might be related to the preservation and regulation of activities of intracellular enzymes of hepatic cells. It has been observed that the early phase of fatty metamorphosis is characterised by a severe disturbance in the enzyme pattern which is reflected by a major loss of pyridine nucleotides—Total, oxidised (PN) and reduced (PNH) a reduction in PN/PNH ratio and total sulphhydryl content and a slight rise, which becomes more prominent at a later stage in the activities of adenosintriphosphatase (ATP-ase), pyrophosphatase, acid and alkaline phosphatase and glutamio-oxalacetic and glutamic-pyruvic transaminases. Vitamin B₁₂ has been shown to bring about a reversal of these changes except in the acid and alkaline phosphatases which were stimulated under the influence of vitamin B₁₂. It is suggested that vitamin B₁₂ may exert its lipotropic action through its regulatory effect on the activities of the enzymes more especially pyridine nucleotides and sulphhydryl enzymes, concerned with the general cellular metabolism.

346. Physico-chemical studies of Vitamin A in Fish liver oils.

R. CHANDA, Calcutta.

Chromatographic and spectrophotometric studies were carried out on the *trans* and *cis* (neo) vitamin A, and vitamin A₂ present in fish (cod, shark) liver oils. Chromatography on alumina by the method of Chanda & Owen showed that the vitamin A in the fish liver oils and in vitamin A concentrate is present almost exclusively as ester (98 to 100%). Chromatographic separation of vitamin A isomers was also carried out by the method of Bro-Ramussen et al. using a 60 cm. × 1.5 cm. column of dicalcium phosphate treated with disodium phosphate. The fractionation curves shows three peaks for neo, all-*trans* and vitamin A₂ in that order for the fish liver oils and vitamin A concentrate. In a sample of Norwegian cod liver oil, 18% of the total extinction was due to neovitamin A and 8% due to vitamin A₂.

The peaks of absorption spectra of neovitamin A and all-*trans* vitamin A between 280 and 380 mμ with a single peak at 328 mμ in n-hexane, and the E values have been discussed. The absorption spectra in n-hexane of vitamin A₂ separated chromatographically from shark liver oil and vitamin A concentrate showed remarkable similarity with two peaks. The peak at 352 mμ was more marked, and the ratio of E₃₅₂/E₃₂₇ was found to be 1.39 as compared with the corresponding ratio of about 0.5 for all-*trans* vitamin A.

Vitamin A in fish liver oils and vitamin A concentrate was also assayed by the application of the 5-point liver storage bioassay procedure of Ames & Harris. The results of bioassay were in close agreement with the spectrophotometric assay using the 3-point correction procedure of Morton & Stubbs. Low spectrophotometric potency of vitamin A concentrate was confirmed by liver storage bioassay.

B-Carotene assayed by the chick liver storage bioassay was found to be 48% as potent as all-*trans* vitamin A.

347. Effect of Post-mortem Period on the Nature of Dehydration during Curing of Hide.

S. C. NANDY and S. N. SEN, Madras.

The efficacy of curing hide or skin depends on the extent and rapidity of both salt absorption and dehydration. The dehydration or the weight loss due to brine drainage and surface evaporation of salted hide has been found to be progressively delayed with the increase in Post-mortem period prior to curing. Such delayed dehydration has been found to be significant during salting and bringing; during simple drying in the absence of salt the dehydration is not affected in the same way. It has been shown that the globular proteins present in the hide and the disintegration products of the other hide proteins, produced by bacterial hydrolysis during Post-mortem period are, at least, partially responsible for such delayed dehydration.

348. Preferential Release of Aspartic Acid by Bacterial Action in Hide-water System.

S. N. SEN, S. C. NANDY and Y. NAYUDAMMA, Madras-20.

In a Hide-water system (1 : 4) bacterial action has been found to liberate aspartic acid preferentially, sometimes within 3 to 4 hours, at room temperature (about 30°C) indicating some special sites in the hide proteins for bacterial attack. Glutamic acid was liberated next, almost simultaneously. These observations as recorded by ascending filter paper chromatography do not indicate liberation of other amino acids within 8 hours. Slight increase in bacterial population within this period could be ascribed to the utilisation of aspartic acid till other products are available.

349. Comparative Biochemistry of Hides and Skins collected from different Regions : I. Distribution of certain Amino Acids, Carbohydrate Constituents and Lipids in Hides and Skins of U.P. and Hyderabad Region.

K. THOMAS JOSEPH, S. M. BOSE and Y. NAYUDAMMA, Madras-20.

As a part of the programme of study of the comparative biochemistry of hides and skins collected from different regions of India, an investigation of the quantitative distribution of some of the characteristic amino acids and other important constituents were undertaken in order to ascertain what difference exists between normal, fallen and diseased hides and skins. A large number of slaughtered, fallen and diseased hides and skins collected from the U.P. and Hyderabad regions were quantitatively analysed for hydroxy-proline, proline, tryptophane, glycerine, tyrosine, total reducing sugars, hexosamines and lipids. A resin hydrolysis method was standardised so as to estimate most of these constituents in a single step on the same sample of the hydrolysate. It was observed that there was a decrease in the hydroxy-proline content in fallen and diseased samples, while the contents of tyrosine proline, reducing sugars and hexosamines were higher in these samples than in the normal slaughtered hides and skins. The fat content of diseased samples was found to be somewhat lower than that of normal samples. The reasons for the difference in the contents of these constituents are discussed.

350. The Optical Configuration of the Constituent Amino Acids of Skin and Hide Proteins.

K. THOMAS JOSEPH and S. M. BOSE, Madras-20.

The optical configuration of some of the amino acids occurring in individual protein components of skins and hides was investigated using certain specific enzymes, viz., D-amino acid oxidase which was prepared from sheep's kidney cortex and L-amino acid oxidase of snake venom. The activity of these enzymes was tested by measuring quantitatively the oxygen uptake of pure amino acids in Warburg's flasks. The extent of the reaction of these enzymes on the protein hydrolysates was studied by quantitative measurement of oxygen uptake and by paper chromatographic analysis of the constituent amino acids after treatment with the amino acid oxidases. Paper chromatography of the L-amino acid oxidase treated protein hydrolysates showed almost complete disappearance from the hydrolysates, of histidine, leucine, isoleucine, methionine, phenylalanine and tyrosine, whereas paper chromatography of the D-amino acid oxidase treated protein hydrolysates still showed the presence of isoleucine, leucine, methionine, phenylalanine, tyrosine, alanine and proline. The oxygen uptake of all the protein hydrolysates with the D-amino acid oxidase was also practically negligible. It is therefore concluded that none of the D- forms of alanine, histidine, isoleucine, leucine, methionine, phenylalanine, proline and tyrosine occur in the proteins of hides and skins viz., collagen, elastin, reticulin, wool, albumin, globulin and mucoid.

351. Estimation of Tannase and Certain Oxidizing Enzymes in Indian Vegetable Tanstuffs.

W. MADHAVA KRISHNA, S. M. BOSE and Y. NAYUDAMMA, Madras-20.

Tannase was isolated from certain fresh vegetable tanstuffs, viz., myrobalan nuts, divi-divi pods, dhawa leaves, avaram bark, babul bark and konnam bark. A method for the quantitative estimation of tannase was developed making use of the colour-forming reaction of liberated glucose and anthrone reagent. The activity of the isolated tannase was quantitatively estimated against tannic acid by adopting this method. Polyphenoloxidase was isolated from the same vegetable tanning materials and the activity was quantitatively estimated by Warburg's manometric technique using catechol as the substrate. Peroxidase was isolated from the above tanstuffs and the activity was quantitatively estimated by a spectrophotometric method. Ascorbic acid oxidase was also isolated from these tanning materials and the activity was quantitatively estimated by the manometric technique using ascorbic acid as the substrate. It was observed that tannase, polyphenoloxidase, peroxidase and ascorbic acid oxidase were present in both hydrolyzable and condensed type of tanstuffs.

352. Nature of the Linkage of Glutamic Acid in Collagen and Elastin.

K. THOMAS JOSEPH and S. M. BOSE, Madras-20.

Many investigators have considered the possibility that primary linkages other than peptide bonds contribute to the stability of the collagen structure. Experiments were therefore carried out to find out whether the γ -carboxyl groups of glutamic acid are involved in the formation of cross-links with other groups in collagen and elastin. Collagen and elastin were partially digested with trypsin and elastase and the resulting peptide mixtures were tested for the presence of γ -glutamyl peptides by oxidising with sodium hypobromite. Succinic acid was removed by ether extraction and the succinyl peptides, insoluble in ether, were hydrolysed by hydro-

chloric acid and the succinic acid liberated was estimated. The amounts of succinic acid obtained by this procedure indicated the presence of a small number of γ -glutamyl bonds in collagen and elastin. When the tryptic hydrolysate of denatured collagen was analysed for the liberated arginine, only about 70% of the arginine bonds were found to be reactive which suggested that some arginine linkings in collagen are much more resistant than others to the action of trypsin. When collagen and elastin were subjected to the sakaguchi reaction with sodium hypobromite, about 70% of the arginine in collagen and practically the whole of arginine in elastin were destroyed. It is suggested that some of the guanidino groups of the arginine, resistant to the action of trypsin and hypobromite in collagen, are involved in bond formation with the γ -carboxyl group of glutamic acid. As all the guanidino groups in elastin were however available for reaction with hypobromite, it is also concluded that the guanidino groups in elastin are not involved in any bond formation with the γ -carboxyl groups.

353. Incorporation of radioactive amino acids into protein in cell-free preparations of *Azotobacter vinelandii*.

MAHARANI CHAKRAVORTY and D. P. BURMA, Calcutta-9.

A particulate preparation of *Azotobacter vinelandii* sedimenting at $30,000\times g$ is capable of incorporating radio-active amino acids into protein. This incorporation is neither stimulated nor inhibited by the cytoplasmic fraction which has considerable amount of amino acid activating capacity. The modes of incorporation of glutamic acid and glycine are found to be somewhat different. The incorporation of the former is dependent on ATP and Mg^{++} whereas that of the latter seems to need neither of them. In both the cases a mixture of 17 amino acids interferes with the incorporation perhaps in a competitive way. The rate of incorporation of an individual amino acid is linear up to about one and half hour and then starts falling. The reaction has a broad pH optimum between 6–8. Treatment of the particulate preparation with 1M NaCl leads to practically no loss of amino acid incorporating activity whereas that with RNase reduces this activity to one-third of the original. The original activity can, however, be restored back by the addition of either yeast RNA or RNA prepared from *A. vinelandii*. The mechanism of incorporation of the two amino acids are being investigated in detail.

354. The Relationship between Auxins and Sulphur Metabolism in Plants.

ARCHANA SEN GUPTA and S. P. SEN, Calcutta.

In view of the important role of sulphur containing compounds in growth an investigation has been undertaken to study sulphur metabolism in growing tissues as affected by auxins, using S^{35} as a tracer. Four day-old Avena Coleoptile and potato tuber were used.

Six mm. Coleoptile sections and potato discs seven m.m. in diameter were floated on the experimental solution containing $Na_2S^{35}O_4$ and IAA of concentrations 10^{-7} , 10^{-5} and 10^{-3} M at pH 6.0 for 3 hours. The tissues were then washed thoroughly and extracted with hot 80% ethanol. Two dimensional paper chromatography of the extracts revealed that low concentrations of IAA has no marked effect on the reduction of sulphate but a concentration of 10^{-3} M completely inhibited sulphate reduction in these tissues. High concentrations of IAA also inhibited the incorporation of S^{35} into protein. Thus one of the possible ways by which the inhibitory action of IAA is exercised appears to be achieved through the complete inhibition of sulphur metabolism in these plants.

355. Effect of Total body X-Radiation on Nitrogen Metabolism in Albino rats.

J. DUTTA, P. N. DAS and K. MUKHERJEE, Calcutta.

In the present investigation the effect of whole-body X-Radiation on a group of six inbred albino rats have been studied, mainly in the excretion pattern of the nitrogenous end products in the urine, with the hope of finding out any indication of derangement in the pathway of nitrogen metabolism in the body. Urea, free ammonia, Uric acid, Creatinine and the amino acids were measured in the 24 hour urine samples on each alternate day for a week. Taurine and neutral sulphur were also estimated in the same fashion, as they are known to be important end-products of sulphur metabolism in living system. The variation of the excretion of the end products analysed were found to be very small from rat to rat. Estimation of the previously mentioned end products were continued for week following irradiation. The total and differential W.B.C. count and R.B.C. count in blood after 12 hours following irradiation were found to fall drastically. The animals became lethargic and averse to food, epilation was also copious. Uric acid and urea, was found to increase appreciably after irradiation, so also, free ammonia but to a much lesser extent. Amongst the amino acids studied the excretions of lysine, leucine, tyrosine and glycine were found to more or less, increase following irradiation where as, the excretions of α -alanine, valine and phenylalanine were not changed. The increase of neutral sulphur and particularly the large increase of taurine was noteworthy. Creatinine excretion remain unchanged. Increased urea and uric acid excretion following irradiation pointed to the possibility that increased breakdown of protein bodies and cell-nuclear materials might be the immediate effect of radiation. The large increase in taurine may be due to the oxidation of $-SH$ group bearing compounds in the living system by the highly oxidising free radicals produced by the radiolysis of the water content of the biological system. The increased out-put of the amino acids suggests a derangement of normal dynamic pool of the amino acids in the living system. The cause of increase of ammonia is obscure.

356. A New Micro-method for the Estimation of Cellulose in Biological Materials.

K. K. SAXENA and R. MUKHERJEE, Izatnagar.

A new method is presented for the determination of microgram quantities of cellulose in biological materials. It consists in digesting the samples for 1 hour with 50% formic acid, treating the residue with 72% H_2SO_4 and subjecting the resulting solution to anthrone colour reaction. The intensity of colour was measured in an absorptiometer, using OR_2 filter (Hilger). It has been found by adding casein and starch to a known amount of cellulose that the observed values are not affected by their addition. The suitability of the new micro-method for the determination of cellulose in biological materials has also been confirmed by comparing the results with those obtained by a modified Crampton and Maynard macro-procedure.

The new method covers a range up to 40 micrograms of cellulose. It is expected to find application in studies on cellulolysis and in the micro-determination of cellulose in general.

357. Urea Denaturation of Bovine Serum Albumin. Reactivity of Sulphydryl Group.

R. C. KAPOOR, Allahabad.

Denaturation of bovine serum albumin has been studied in presence of 6 M Urea. The reactivity of the sulphydryl group has been observed amperometrically,

using rotated platinum electrode. Studies were made at pH 7 in phosphate buffers at 25°.

The sulphhydryl of undenatured albumin reacted with silver and mercury in the same molar ratio, forming compounds of the type (PSAg) and (PSHgCl), (protein molecule represented by (PSH)). During denaturation the sulphhydryl progressively forms dimer with mercury of the type (PS)₂Hg. After 24 hours of denaturation, most of the -SH formed dimer with mercury.

The reaction ratio as determined by amperometric titrations thus offer a new approach to the study of structural changes involved in the process of denaturation.

358. Action of Urease on Blood Urea *in vivo*.

R. L. NATH, Calcutta.

Urease prepared from *Cajanus indicus* was injected intravenously in 6 dogs under anaesthesia with sodium pentathenate and the effect on the blood urea was observed by estimating it before and after administering urease. The average lowering of blood urea in 45 minutes after injection of urease was 28% of the original value. That the anaesthesia did not effect blood urea under similar conditions was shown by estimating it in two dogs in which no urease was injected. All the dogs revived from anaesthesia.

359. The Component Acids of Indian fresh water Fish Magur (*Clarius Betrachus*) Fats.

S. P. PATHAK and B. R. REDDY, Varanasi.

Clarius betrachus (Magur fish) body and liver fats have been studied for their component acids by the usual crystallisation and ester fractionation techniques. The fatty acid composition (by % wt.) of the body and liver fats is : Myristic acid = 3.02 and 3.75; Palmitic = 23.93 and 23.08; Stearic = 6.92 and 4.43; Arachidic =

0.32 and Nil; and among unsaturated C₁₁ = 0.88 and 3.59; C₁₆ = 14.89 and 34.19; C₁₈ = 40.02 and 30.96; C₂₀ = 6.94 and Nil; C₂₂ = 3.05 and Nil
 (–2.0H) (–3.2H) (–3.8H) (–6.5H) (–2.0H) (–2.4H) (–10.0H)

respectively. The % of sat. acids is higher like other fresh water fish fats of Indian origin than their counterparts of British origin and thus supporting the view of Pathak co-workers that biohydrogenation occurs to a greater degree in fish fats of tropical origin. It is also observed that the Magur liver fat showed significant differences when compared with other liver fats of Indian fresh water species, in its fatty acid composition and the authors are of the opinion that such variation cannot be ruled out.

360. "Studies on metabolic degradation of Pamaquin (Plasmaquin) in Monkeys".

H. L. BAMI, M. S. DHATT, G. S. AHLUWALIA and A. P. RAY, Calcutta.

Studies on metabolic degradation of pamaquin *in vivo* have been undertaken with a view to elucidate the mode of action and detoxification of this potent curative anti-malarial. Pamaquin citrate has been administered orally and intravenously to healthy monkeys at maximum tolerated doses. Attempts have been made to isolate and characterise its metabolites in monkey urine and faeces by solvent extraction, chromatographic, ultraviolet absorption and other micro-chemical

techniques. It was found that pamaquin was extensively oxidised in the system and excreted as simple soluble metabolites. Mild chemical oxidation of pamaquin led to the formation of quinolinic acid, nicotinic acid and other smaller soluble fragments. Estimation of nicotinic acid in monkey urine both before and after pamaquin administration also revealed that pamaquin administration led to increase in nicotinic acid excretion. In view of present and previous findings, it appeared that pamaquin *in vivo* was ultimately oxidised, via its 5:6-quinoline-quinone derivative, into quinolinic acid, nicotinic acid and their subsequent metabolites. A scheme for pamaquin degradation has been outlined and discussed in relation to other antimalarial drugs of 8-amino and 4-amino quinoline groups.

361. Studies on Thiaminase, Part I : Action of the analogues of Vitamin B₁ and some quaternary bases on the action of thiaminase.

S. D. VERMA and A. N. DIXY, Kanpur.

It has been established that chasteek paralysis of foxes noted by Green, R. G. etc. (1941,1942) is due to a heat labile enzyme, called thiaminase, and it is found widely distributed in fresh water fishes, in some ferns and also in some bacterias. We have found that this enzyme is also found in the fresh water fishes found in India. Since this enzyme has been reputed to be responsible for the cleavage of the quaternary compound thiamin hydrochloride it was considered that a study of its action on analogues of vitamin B₁ and similar other quaternary salts may furnish clue to the mechanism of the action involved in this cleavage process. This is a preliminary report of our experiments on the subject and it deals with the effect of such compounds on the action of thiaminase. In this way quaternary compounds obtained from many pairs of compounds were tested for the purpose.

It has been noted that some these compounds activate the enzymatic reaction, whereas some of them are weak inhibitors and act also as potential inhibitors.

362. Crystalline Proteolytic Enzymes from Bacterial Culture Filtrates.

DURLAV K. ROY, JYOTIRINDRA DATTA and KSHIROD R. BHATTACHARYA, Calcutta.

Microbial proteases mostly by aerobic cultures have been found to be promising for large-scale production because of its low cost of production and large demand by industries. It has become more important when the limit of activity of the vegetable material, like papain, and the lack of properly developed and organised slaughter houses for production of pancreatic materials are considered. There is an increasing demand of proteolytic enzymes for 'bating' in leather industries and purified proteases in pharmaceutical and food industries.

In the present investigation microbial proteolytic enzymes from submerged culture of a locally isolated strain of aerobic organism of *Bacillus subtilis*-type (RDB₁₁), grown in a medium containing wheat bran (5%) and ground nut cake (0.5%) for 60 hrs. at 35-37°C, were obtained in very concentrated and purified state. The culture filtrate, after clarification with Hyflo-super cel (2%) was fractionated in stages with ammonium sulphate and chilled ethanol. A purified dry preparation was obtained by drying the ethanol-precipitated material *in vacuo*. This material showed wide pH range of activity from 6.8 to 10.6 and paper electrophoresis of this material showed two bands. A crystalline material, heterogeneous crystals—thin plates and needles—slowly appeared from half-saturated ammonium sulphate solution of the purified material; the crystalline material showed very high protease activity when examined by colorimetric method of Anson. It seems more than one proteases are present in the purified proteolytic material from bacterial culture filtrates.

363. Phosphorylase of *Trapa Bispinosa* Fam. Trapaceae (Panifal).

JYOTIRINDRA DATTA, KSHIROD R. BHATTACHARYA and DURLAV K. ROY,
Calcutta.

The average phosphorylase activity of the kernel of panifal is comparable to that of potato. To frozen panifal kernel kept in a waring blender was added equal weight of water. After homogenizing for 2-3 minutes juice was collected by centrifugation. Preliminary fractionations were made at 0.30 to 0.50 saturation by dissolving calculated amount of solid ammonium sulphate with mild but constant stirring below 5°C. The pH was kept at 6.6-6.8 with ammonium hydroxide. The suspension was centrifuged after 1 hour. The precipitate was suspended in a suitably small volume of 0.1 (M) citrate buffer at pH 6.8. Further fractionation was conducted as before with solid ammonium sulphate under identical conditions. The greater part of the activity now appeared in the fraction separated between 0.26 and 0.43 saturation with ammonium sulphate.

The phosphorylase activity of this preparation was not affected by 0.1 (M) Sodium fluoride. Maximum activity was exhibited at pH 6.2 and at a temperature around 55°C. The enzyme was completely dependent on starch as the primer. Hg^{++} , Cu^{++} and Ag^{+} inhibited the enzyme even in low dilutions while other common cations and anions were without any effect. The inhibition by Hg^{++} was completely reversed by cysteine and reduced glutathione. Muscle adenylic acid was without any effect on this enzyme preparation.

364. Microbiological Transformation of Terpenes—A new fermentation.

PREMA. B. RAMAN, S. K. PRADHAN, B. D. KULKARNI and
P. K. BHATTACHARYYA, Poona.

It has been known for some time that the yields of some essential oils from plant material are affected by the microbial infection of the oil-bearing plants. However, clear-cut evidence that the micro-organisms are capable of giving rise to oxygenated products from terpenoid hydrocarbons as substrate is not available. The present studies were undertaken in order to investigate the ability of micro-organisms, especially fungi, to convert simple terpenoid hydrocarbons, such as α -pinene, to oxygenated essential oils.

After a preliminary screening of different strains of fungi, a strain of *Aspergillus niger*, was selected for further investigations. This mould was found to metabolize pinene at a comparatively rapid rate in shake cultures. From the fermentation broth and the mycelium three oxygenated derivatives were isolated by solvent-extraction, solvent-solvent distribution, fractional distillation, bisulphite treatment and chromatography; (i) a liquid alcohol $\text{C}_{10}\text{H}_{18}\text{O}$, (ii) a liquid ketone, $\text{C}_{10}\text{H}_{16}\text{O}$ and (iii) a crystalline diol, $\text{C}_{10}\text{H}_{18}\text{O}_2$ (m. 145-146°, $[\alpha]_{28}^D +152^\circ$).

The chemical nature of these transformation products and the probable mechanisms leading to their formation from α -pinene will be discussed.

365. Effect of Sod. β -hydroxybutyrate on the potency of exogenous Insulin.

H. D. BRAHMACHARI and MAHENDRA KUMAR, Pilani.

Lipogenesis is greatly influenced under diabetic conditions. The metabolic blocks in diabetes result in the accumulation of ketone bodies like β -hydroxybutyric acid (I). This compound being an important fat metabolite, was studied

for its effect on the biological potency of exogenous insulin in the normal fasting rabbits.

Sodium salt of (I) was used for its effects on insulin potency both, 'in vivo' by simultaneously injecting along with insulin in the different legs of fasting normal rabbits, and 'in vitro' by mixing a trace of this compound with insulin. The blood sugar fall/hour by these injections was compared with the response obtained by injecting pure insulin only.

It had been observed that the Sod. salt of (I) lowers the potency of insulin both 'in vivo' as well as 'in vitro'. This decrease in insulin potency could be a result of a sort of inactive type of complex formation of (I) with insulin, or it might be a physiological response to a disturbance in the equilibrium of carbohydrate and lipid metabolisms brought about by (I) or both.

366. Effect of Sodium Succinate on the potency of exogenous Insulin.

H. D. BRAHMACHARI and MAHENDRA KUMAR, Pilani.

It has been seen that under diabetic conditions Kreb's cycle is depressed on the whole. Further, the discovery that a good number of metabolic enzymes are housed in the mitochondria imparts a great importance to the concentration of TCA members in the systems.

The present study gives the result of the effects of one of such members Sodium Succinate (I) on the potency of exogenous insulin.

Results indicate that both 'in vitro' and 'in vivo', (I) increases the potency of exogenous insulin assayed in rabbits. This increase in the action of insulin by (I) may be a result of an increase in the activity of the C.M. system enzymes which may lead to an increased glucose uptake rate in the system or some sort of potentiating type of complex formation between (I) and insulin.

367. Effect of Tryptophan and Niacin on the potency of exogenous Insulin.

H. D. BRAHMACHARI and MAHENDRA KUMAR, Pilani.

Earlier workers have observed that insulin can decrease the plasma amino acid level. This decrease has been suggested as an evidence of an inter-relationship of increased utilization of carbohydrate metabolism with a net gain in the protein metabolism.

The present study has been carried out to note the effects of essential amino acid, 'Tryptophan' (I) and its metabolite 'Niacin' (II) on the potency of exogenous insulin in rabbits. Results show that both (I) and (II) potentiate the insulin potency 'in vivo' and 'in vitro'; and the effect of (II) is much more significant than that of (I).

Insulin potentiating effect of (I) and (II) may be due to their being insulinase inhibitors (Mirsky). The more pronounced effect of (II) raises a question if the effect of (I) is its own primary effect or a secondary effect of its first, being metabolised to (II).

368. Studies on Pulse Protein—Part II. Association with Thiamine and Nicotinic Acid content of pulses.

G. C. ESH and T. S. DE, Calcutta.

An investigation from this laboratory has established a wide difference in the protein content of different pulses grown in different parts of India. It was

considered to be of interest to find out its vitamin content of B group and in such a study thiamine, nicotinic acid have been estimated in different pure-bred samples of Bengal gram, green gram, red gram, black gram, dried peas, khlesari and lentil.

The results of the analysis tend to show significant variations in the occurrence of these essential nutrients as a result of strain difference. The strain having high protein content may not give high values of either thiamine or nicotinic acid and *vice-versa*.

In view of significant variations in thiamine and nicotinic acid contents under influence of strain difference, further work is in progress regarding the degree of absorption and utilization of B-vitamins in pulses

369. Digestibility of Vanaspathis from Tobacco Seed oils and Safflower seed oils.

M. M. CHAKRABARTY and M. K. CHAKRABARTY, Calcutta.

Tests have been carried out on the digestibility of hydrogenated tobacco seed oil and safflower seed oil by rat experiments. Groundnut oil and 'Dalda Vanaspathi' were used as controls. From the biological experiments it was observed that there was practically no difference between dalda and hydrogenated tobacco seed oil and hydrogenated safflower seed oil. It was also found that the tobacco seed oil Vanaspathi was non-toxic and safe. From the results of these experiments it would seem that there should not be any difficulty for the utilisation of safflower and tobacco seed oils for edible purposes in the form of hydrogenated products.

370. Studies on the biosynthesis of fats.

M. M. CHAKRABARTY, B. T. R. IYENGAR and S. K. DAS, Calcutta.

Further work has been carried out on the problem relating to assimilation of conjugated fatty acids present in Karela (*Momordica Charantia*) seed fat. Feeding experiments were conducted on rats for two weeks, five weeks and twelve weeks against groundnut oil as control. After the experimental period the animals were sacrificed and the fat extracted from the body and liver respectively, were analysed. Firm indications were obtained of deposition of linolenic acid in both the body fat and the liver fat of the experimental group although the deposition of α -elaeostearic acid was not observed. In view of the fact that the experimental fat did not contain any linolenic acid and the conclusion was that bio-isomerisation of the conjugated triene (elaeostearic) to nonconjugated triene (linolenic) acid was taking place. It was also found that the rate of deposition of non-conjugated triene acid increased with the increase of length of experimental period. The rate of deposition in the body and the liver was however different, comparatively more being found in the liver for the same period.

371. Biochemical changes in Germinating Seeds of *Sesbania Grandiflora* Pers. (Agathi).

P. V. SUBBA RAO, M. V. L. RAO and M. SRINIVASAN, Mysore.

Prominent among the changes observed in the course of germination of these high-protein seeds over a 96 hour period are :

- (a) Absence of any considerable changes in the pattern of the proteins,
- (b) a marked increase in both sucrose and free reducing sugars,
- (c) the formation of small amounts of starch, entirely absent in the original seed,

- (d) the role played by the inner seed coat (tegmen) as a source of free sugars for the synthesis of sucrose, and
- (e) the large increase in ascorbic acid content.

372. Physiological Role of Essential Fatty Acids, Inositol, Vitamin B₁₂ and Hydrolyzed Glucose Cycloacetoacetate on Blood Coagulation Factors in Saturated Fat induced Atherosclerosis in Rabbits.

M. C. NATH and A. SAIKIA, Nagpur.

Prolonged feeding of highly saturated fat diet to the extent of 20% to the rabbits which leads to the experimental atherosclerosis has been found to shorten the coagulation factors viz. bleeding time, coagulation time and prothrombin time to increase the liver fat and the number of blood platelets and to increase ester cholesterol in blood and tissues. It has been discussed how rise of tissue ester cholesterol especially of the superficial intima layers may activate blood platelets thus leading to the increased coagulability of blood and thrombosis. Administration of essential fatty acids, inositol, vitamin B₁₂ and hydrolysed GCA has again been shown to check such shortening of coagulation factors and the mechanism of such action has been discussed.

373. Studies on the effect of B-Vitamins on the Biosynthesis of Ascorbic Acid from Glucose Cycloacetoacetate in Germinating Phaseolus Radiatus.

M. C. NATH and M. L. BELKHODE, Nagpur.

The anti-vitamins i.e. pantooyltaurine and pyrithiamine have been found to inhibit the ascorbic acid biosynthesis from acetoacetate and glucose in germinating mung beans thereby giving an indication of blocking the condensation reaction of acetoacetate with glucose to form GCA (Glucose Cycloacetoacetate). The corresponding vitamins have been found to reverse the inhibition by antivitamins. That pyrithiamine and pantooyltaurine inhibit the synthesis of ascorbic acid in presence of GCA and the corresponding vitamins reverse inhibition, has also been observed. Cocarboxylase and GOA of which thiamine and pantothenic acids are the constituents are involved in both the condensation reaction of glucose with acetoacetate to form GCA and in further metabolism of GCA to ascorbic acid.

374. Studies on the High Fat and High Protein induced Atherosclerosis and the beneficial role of Essential Fatty Acids, Methionine and Glucose Cycloacetoacetate.

M. C. NATH and A. SAIKIA, Nagpur.

The effect of feeding high level of fat and protein diet (20% dalda and 40% egg albumin) on the plasma and tissue lipid levels and their C/P (Total Cholesterol Lipid Phosphorus) ratios were investigated in the rats.

This diet was found to develop hypercholesterolemia and atherosclerosis.

On injection of hydrolysed GCA or on supplementation of dl-methionine, linoleic acid, linolenic acid respectively to the animals along with this diet was found to reduce the plasma and tissue lipid levels.

Combined effect of GCA (hydrolysed) and linoleic acid or methionine and linoleic acid was found to be much better in maintaining the plasma and tissue lipid levels and the C/P ratios than individual use of these substances.

The combined effect of high fat and high protein diet brought about the development of hypercholesterolemia and atherosclerosis more quickly than those of high fat and high protein alone.

375. The Effect of Chelating Agents on the Distribution of Cobalt-60 in rats.

V. M. SIVARAMAKRISHNAN, Madras.

In an attempt to control the distribution and excretion of cobalt-60 at will, the changes produced by sixteen chelating agents on the distribution pattern of cobalt have been studied. Groups of rats were treated with tracer cobalt only ("controls"), or tracer cobalt with any one chelating agent. After 24 hours, the radioactivity in various organs, blood, urine and feces, collected separately, was determined with a scintillation counter. While 75% of the injected cobalt is excreted within 24 hours in the control rats (mainly through urine), it has been possible to achieve a 46% localization in the liver with rubanic acid (31% by BAI), a 40% localization in the intestines with sodium diethyl dithiocarbamate and a 26% concentration in the blood with riboflavin. 1-nitroso-2-naphthol effectively decreases the excretion to 14%. Oxine causes a forty-fold increase in the activity of lungs. A conspicuously-low deposition of EDTA-complex in all organs, except the intestines, has been observed. Cysteine and sodium hexametaphosphate significantly increase the excretion to over 85%, and may be useful in eliminating previously-deposited radio cobalt. Chelating agents offer great promise in radio therapy.

376. Changes in blood Pyridine nucleotide levels during the functional improvement of liver using packed red cell transfusion in cirrhosis of liver.

P. J. MODI, S. G. JOSHI and R. G. CHITRA, Bombay.

Six cases of cirrhosis of liver were studied to correlate the changes in blood Pyridine Nucleotides level (PN) with protein synthesis as judged by serum proteins and haemoglobin during the progressive improvement of liver function using red packed cell transfusion as source of protein. These enzymes may show manifestation earlier than other blood constituents during functional improvement. It is possible that in cirrhosis of liver the binding capacity of liver for the enzymes may itself be reduced perhaps due to the depletion of cytoplasmic proteins. Secondly, cirrhosis of liver is sometimes accompanied by anaemia and blood PN may not be utilised by bone marrow. The results so far obtained indicate that after the institution of red packed cell the capacity of liver to bind these enzymes is increased and PN may be utilised by bone marrow as the anaemic condition is improved.

377. Purification and Properties of Galactokinase from Ox Brain.

D. K. BASU and B. K. BACHHAWAT, Vellore.

The conversion of galactose to glucose or incorporation of galactose into cerebrosides has been shown to be intimately linked to the metabolism of uridine nucleotides. It has been established, both in yeast and animal tissues, that galactose must first be converted to galactose-1-phosphate by galactokinase and adenosine triphosphate.

In this study, the enzyme galactokinase was partially purified from ox-brain and some of its properties were studied. The enzyme was purified 40-fold by zinc

ion fractionation method. The enzymatic reaction showed pH optimum of 6.0 in succinate buffer. Glucose, glucosamine, N-acetylglucosamine and galactosamine in equimolar quantities were not phosphorylated by the brain galactokinase. The enzyme required Mg^{++} and cysteine for maximum activity.

378. Search for new Fungicides.

B. B. RAUL and G. N. MAHAPATRA, Cuttack.

In the present paper, the synthesis of a series of 2-(p-chlorophenyl imino)-3-p-chlorophenyl 4 : 5 substituted thiazolines has been reported by the action of various ketones on Sym-d-p-chlorophenyl thionrea in presence of iodine. These thiazolines have been mercurated and the resulting mono-acetoxy-mercuric compounds so obtained have been assayed for their fungicidal activity. *Pergularia Lunata*, has been used as the test fungus. Most of the mercurated compounds have suppressed germination of the spores to an extent of 75—80% at a concentration of 10 p.p.m., while in the control the germination was 65—80%. This fungicidal activity was quite promising. The method of Montgomery and Moore (J. Pormol & Hort Sci, 15, 253, 1938) with slight modification has been used for the fungicidal assay during the work.

379. Phosphorylase from Jack fruit seeds (*Artocarpus integrifolia*).

Miss S. P. GUPTA and N. R. KALE, Poona.

Presence of phosphorylase enzyme has been shown in the saline extracts of jackfruit seeds. Phosphorylase which catalyses the synthesis of starch from glucose-1-phosphate in presence of a primer (starch) at pH 6.0 ($\mu=0.5$ m) was investigated by determining the liberation of inorganic phosphorous as well as the estimation of starch by its colouration with iodine. Further work on isolation of enzyme in purer form is in progress.

The seeds are found to be rich in starch. Besides starch, they contain a considerable amount of pectin. Preliminary chemical analysis of the jackfruit seeds shows 50% moisture, 0.1838% total nitrogen (protein) and 0.1983% phosphorus.

380. Determination of N-terminal groups of purified beef fibrinogen and fibrin by Sanger's FDNB method.

N. R. KALE, Poona.

N-terminal amino acids of purified beef fibrinogen (97-98% coagulable) and fibrin (clot) were determined by Sanger's FDNB method. The results have shown the presence of two tyrosine and one glutamic acid as N-terminal amino acids in fibrinogen and equivalent amount of fibrin contained two tyrosine and four glycine residues.

This change in the N-terminal pattern of the parent molecule is most probably mediated by the limited and controlled proteolysis of thrombin, characterized by the fission of glycyl peptide bonds within the fibrinogen molecule with a simultaneous loss of N-terminal glutamic acid residues.

381. Effect of altitude and soil treatment on nutrition and cardiotonic activity of *Digitalis Purpurea*.

B. P. GHOSE, S. K. BOSE and B. N. DAS, Calcutta.

Digitalis Purpurea plants of 6--7 months old, grown at altitudes of 2000 ft., 3250 ft. and 5000 ft. with soil treatment of ammonium sulphate, potassium sulphate and superphosphate were examined to ascertain the most suitable conditions for cultivation. Nutrition of the plants were studied by estimating total nitrogen, amino nitrogen and total Ash content, the cardiotonic activity being assessed by determination of glycoside content and biological potency.

The results indicate that plants with soil treatment N2P2 at 2000 ft. and 5000 ft. altitude have higher Nitrogen content than the plants at 3250 ft. With N2K2 treatment no significant difference was noted. With soil treatment K2P2 total Nitrogen content was uniformly low at all altitudes.

Amino nitrogen content was found higher in leaf at 3250 ft. with soil treatment N2K2. With K2P2 amino nitrogen content was low for all altitudes. Ash content was similar to amino nitrogen content. With soil treatment N2P2 biological potency was low for plants of 5000 ft.

N2K2 treatment showed low biological potency for plants of 3250 ft.

K2P2 treatment gave discouraging results for all altitudes. Soil treatment N2P2 showed good results, for all altitudes. Soil treatments N2K2 and K2P2 were observed to be not favourable. Plants grown at 2000 ft. with N2P2 and N2K2 treatment gave encouraging results.

382. Infant Food from Buffalo Milk. VII. Shelf life of roller dried infant food from buffalo milk.

M. R. CHANDRASHEKHARA, M. NARAYANA RAO, M. SWAMINATHAN,
D. S. BHATIA and V. SUBRAHMANYAN, Mysore.

The keeping quality of roller dried infant food prepared from buffalo milk and packed in air has been studied. The infant food prepared from milk collected under conditions prevailing in the dairy had a shelf life of 10 months at 37°C and an expected shelf life of 20 months at room temperature (25°—29°C). The thiobarbituric acid value of the infant foods increased steadily during storage. Fair agreement was observed between the thiobarbituric acid value and the organoleptic acceptability of the stored food. Thiamine present in the food was lost to the extent of 15% and 25% respectively when stored at room temperature and 37°C for a period of one year.

383. Studies on the estimation of Beta-Alpha lipoprotein ratio in human serum by paper electrophoresis.

SM. MANJU MUKHERJEE (GANGULY) and DR. B. P. GHOSH, Calcutta.

The estimation of Beta-Alpha lipoprotein ratio in serum has assumed a diagnostic importance for atherosclerosis. In the present method the acetyl derivative of Sudan Black "B" has been used for the purpose of prestaining of lipoproteins. The use of acetyl derivative of the dye which completely shrinks at 104°C gives best results. A saturated solution of this derivative in 95% Ethanol was mixed with serum in the ratio of 1:5. The electrophoresis was carried out with a buffer pH 8.6 (Sodium barbital 29.4 gms., Sodium acetate 19.4 gms., 0.1N HCl 180 c.c., vol. made to 4 litres) at 110 volts and current strength 1 milliamp over an effective length of 28 cm. of paper. The period of run was 5 hours. Sugar and

Cholesterol (total and free) of plasma were also estimated at the same time. In diseases of the cardiovascular system like acute left ventricular failure, myocardial infarction, and congestive cardiac failure, the Beta-Alpha lipoprotein ratio has been found to be uniformly high (Range 3.62—5.38). In other cases, the result has been on the low side (Range 1.95—2.13).

384. Influence of Nicotinic Acid on the Serum Cholesterol Levels in Healthy, Pregnant and Anaemic Indian Women.

M. G. CHITRE and P. R. BHATIA, Bombay.

Recently Altschul et al (4) have shown that it is possible to influence serum cholesterol and experimental arteriosclerosis by increasing oxidation in the tissues using ultraviolet or increasing O₂ tension in the inhaled air. For this reason nicotinic acid which is a component of the respiratory co-enzyme system was investigated. That an oral dose of nicotinic acid should influence the serum cholesterol levels was of interest. Studies were undertaken on normal healthy college students, normal pregnant woman and women suffering from pregnancy of anaemia.

The normal females showed increase in the haemoglobin percentage and total pyridine nucleotides. However total and free cholesterol showed a decrease after the oral administration of 500 mg. of nicotinic acid. The normal pregnant cases also showed an increase in Hb and Total pyridine nucleotides in the blood and decrease in the levels of NMN, total and free cholesterol. In anaemia of pregnancy no significant change was observed in these factors due to the administration of nicotinic acid.

385. New Antimony Salts as Mordant-Fixing Agents in the Textile Dyeing Industry.

V. R. MALLIKARJUNESWARA, Bangalore-3.

Some New Double Salts of Antimony have been prepared and have been suggested as cheaper but equally efficacious "Antimony Salts" for use as Textile Mordant Fixing Agents in place of Tartar Emetic and other costly commercial salts.

Their "Fixing" property and cost of production in this country have been compared with those of the commercial "Antimony Salts".

386. Use of Ethylenediaminetetraacetic Acid for Estimation of Calcium in Sugar House Products.

N. A. RAMAIAH and VISHNU, Kanpur.

The behaviour of ethylenediaminetetraacetic acid to form stable complex with Ca⁺⁺ has been employed for estimation of Ca⁺⁺ in sugar house products such as cane juice, molasses, etc. These last are clarified with lead subacetate and the interfering Pb⁺⁺ in the filtrate is eliminated by addition of adequate quantity of K₄Fe(CN)₆. The filtrate containing Ca⁺⁺, was titrated in ammonical medium, using murexide, as an indicator. The method appeared suitable for routine analysis in sugar factories.

387. Determination of Melassigenic Factors of Different Salts.

N. A. RAMAIAH and VISHNU, Kanpur.

Salts combine with sugars to form complexes which are responsible for the formation of molasses. No quantitative data on the melassigenic factors of the

different salts is available in the literature. Employing the changes in optical rotation accompanied by the addition of a salt to a sugar solution the melassigenic factors (K) were evaluated by employing the following formula derived from the application of law of mass action to the reactions involved.

$$\Delta\alpha = \frac{C_A C_B}{(C_A + C_B + I/K)} \cdot \{ [M_B] - [M_{AB}] \} \cdot \frac{1}{10}$$

K for potassium salts is more than that for sodium salts in accord with the experience of sugar technologists to the effect that the potassium salts are more melassigenic than the sodium salts.

388. Some observations in Isomerization of Linoleic acid rich drying oils.

M. V. KULKARNI and K. K. DOLJE, Poona.

Safflower seed-oil and tobacco seed-oil which are rich in linoleic acid contents were isomerized with catalysts such as iodine and compounds of iodine which liberate iodine when heated with oil. Optimum conditions for isomerization are : (i) 1% of iodine or equivalent amounts of the iodine compound catalysts; (ii) 180°C. or higher temperatures. At higher temperatures the reaction is very rapid. Maximum percentage conjugation obtained was 40%. It is found that higher percentage of conjugation is not attained because of the polymerization of conjugated oil and the reversible nature of the reaction. The reversible nature of isomerization reaction has been confirmed by preparing highly conjugated methyl esters of mixed fatty acids of the oils and subjecting them to action of the isomerizing catalyst. It is observed from molecular weight data that very little polymerization takes place at lower concentrations of the catalyst; while the conjugation is destroyed by the reverse reaction of de-conjugation. However, at higher concentrations of the catalyst the polymerization reaction predominates indicating that iodine catalysts are also good polymerizing catalyst at higher concentrations.

389. Isomerization, Polymerization and Solvent Fractionation of the Seed-Oil of *Xanthium strumarium*.

K. K. DOLJE, Poona.

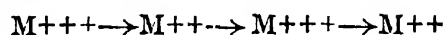
The seed-oil of *Xanthium strumarium* was subjected to thermal polymerization, isomerization and solvent fractionation. It seems that intramolecular condensation occurs during thermal polymerisation. Solvent fractionation of the oil with anhydrous acetone does not yield any fraction with enriched unsaturation. But fractionation of the oil thermally polymerised at 280°C. for twelve hours yields a fraction with good polymerization and drying properties. The oil was isomerised with anthraquinone catalyst which yielded an oil with 20.47% conjugation. The dried films of the isomerised oil exhibited good water, alkali and solvent resistance. The isomerised oil shows much shorter drying time than the thermally polymerised oil. The decorticated seeds were heavily infested with rats and they thrived well over the seeds. It seems, therefore, that the oil is an edible oil.

390. Low Temperature Liquid Phase Oxidation of Paraffin Wax.

MOHAN LAL KHANNA, New Delhi.

In order to utilize surplus wax in the country, liquid phase air oxidation of paraffin wax in the presence of different catalysts has been studied at low tem-

peratures. The reaction is catalysed by reducing the length of induction period of 45 hours observed with paraffin alone. The catalyst sequence of :



etc. of the metal ions in the -ic and -ous states fits in with the generally accepted theory of hydrocarbon oxidation with organic peroxide formation through a free radical chain reaction.

Of the catalysts studied manganese resinate has been found to be the best for the production of acids. The use of boric acid as a catalyst has been studied exhaustively. In general, with an increase in the catalyst concentration, boric acid suppresses the formation of acidity by helping in the production of alcohols with which it reacts to form esters that resist further oxidation.

Metallic copper and its compounds as catalysts have also been studied. In lower concentration they affect a slight reduction in the induction period. With higher concentrations, the entire mass of paraffin wax goes black at the end of 40 hours of oxidation. The reaction is very complex and not much understood at present.

391. Seed-oil of *Citrus vulgaris* as a drying oil.

K. K. DOLÉ, Poona.

Oil from the kernels of the seeds of *Citrus vulgaris* has been extracted and its physical and chemical characteristics have been determined. The average values are : I.V. Wij's 121.7, Sap. V, 192.4, Ref. Index 40°C. 1.4667, A.V. 9.2 and unsaponifiable matter 1.16%. The oil is an edible one with pale yellow colour. Thermal polymerization of the oil at 280°C yields a fairly good stand oil. Solvent fractionation of semipolymerised oil with anhydrous acetone gives a fraction which can be used successfully for oleo-resinous varnishes. Isomerization of the oil with anthraquinone as catalyst considerably improves its drying properties. Mixed fatty acids of the oil are suitable for the preparation of alkyds. The medium oil alkyds give good baked finishes. The seed cake contains 9.8% nitrogen indicating that it would be useful in biscuits.

392. Utilization of the Seed-oil of *Argemone mexicana*.

K. K. DOLÉ, Poona.

Argemone mexicana grows wildly and is a nuisance to the agriculture. The seeds are sometimes mixed with mustard and the mustard oil expressed from the adulterated seeds has been found to be harmful to human beings. Experiments have been carried out to utilise the seed-oil of *Argemone mexicana* as drying oil. The average iodine value (Wij's) of the oil is 122 and therefore it can be classed with semidrying oils. Thermal polymerization alone is not sufficient to improve the drying properties of the oil, but solvent fractionation of the thermally polymerised oil yields a good drying fractions. Isomerization of the oil with anthraquinone catalyst considerably improves the drying properties of the oil. Mixed fatty acids of the oil are suitable for the preparation of alkyds. The baked films of the alkyds show good alkali and water resistance. It seems that further work on these lines would be useful in developing the oil as a drying oil.

393. Recovery and Solvent Fractionation of Sisal Wax.

K. K. DOLE, Poona.

Wax from sisal leaves (*Agave* species) has been extracted with solvents and its physical and chemical properties studied. It is possible to extract the wax from the waste product of the sisal fibre industry and can be developed as a product of cottage industry. Sisal wax is superior to carnauba wax in hardness and gloss. It can be also used as melting point booster for other waxes. The wax has fractionated with n-hexane and fraction having a melting point 102°C. has been obtained. The wax if properly collected has a white green colour and needs no bleaching. The colour can be further improved by bleaching with a mixture of potassium dichromate and sulphuric acid. About 500 tons of wax can be collected annually as a bye product of sisal fibre industry.

394. Recovery of Phenol, Cresol and Xylenol concentrates from low temperature tar oil.

S. MOINUDDIN AHMED, JAFFAR ALI KHAN, M. G. KRISHNA, S. HUSAIN ZAHEER, Hyderabad-Deccan.

Crude tar acids, separated by alkali extraction and acid treatment from the light tar obtained by low temperature carbonisation of non-caking Kathagudem coal, were decolled and distilled under vacuum (70–75 mm.) to give a distillate up to 139°C consisting mainly, of low boiling tar acids and a residue consisting of high boiling tar acids and pitch. The distillate was further fractionated under vacuum (70–75 mm.) to give four cuts. (i) with 60% phenol and 40% o-cresol, (ii) with 80% O-cresol and 20% m- and p-cresols, (iii) with 65% m & p-cresol and 35% low boiling xylenols and (iv) with 82% low boiling xylenols. The neutral oil content of the fractions were within the limits prescribed by the Indian Standards for cresylic acid.

395. Underground corrosion of Metals and alloys.

B. CHATTERJEE, Howrah.

In continuation of our work on the underground corrosion of metals and alloys, the corrosion in Sibpur soil of a sample of wrought iron (C, 0.05%; M_n , 0.15%; P, 0.07%; S, 0.02%; S_1 , 0.13% and slag, 1.40%), a sample of mild steel (C, 0.25%; M_n , 0.53%; S_1 , 0.15%; P, 0.03%; and S, 0.035%) and of a specimen of Cast iron (C, 3.08%; S_1 , 0.88%; M_n , 0.216%; P, 0.21% and S, 0.10%), has been studied by determining the losses in weight of small discs made of these materials, kept buried in this soil for six months and also by determining the combined weight losses of the corrosion cell electrodes after exposure to the Sibpur soil for six months in an atmosphere of saturated water vapour. The corrosion of wrought iron has been found to be the least while that for mild steel and cast iron is about the same. The combined losses in weight of the electrodes in the corrosion cells have been found to be somewhat less than those observed under field conditions for the same interval of time.

396. Hemicelluloses from bagasse, Part I—The nature of the sugars present.

B. C. BANERJEE, S. BOSE and S. MUKHERJEE, Kanpur.

Hemicellulose B has been isolated from the pith of bagasse, which was ground to a fine powder. Wax and free sugars were removed by boiling with ethanol-ben-

zene (2:1) mixture and then with a large excess of water. The treated bagasse was then delignified by treatment with 0.7% NaClO_2 to give the holocellulose. This product was extracted successively with 2% Na_2CO_3 , 4% KOH and 10% KOH; acidified to pH 4.6 (acetic acid) and precipitated with ethanol. The precipitate was washed several times with increasing concentration of ethanol and finally with absolute alcohol, giving three hemicellulose fractions in 2.5%, 14% and 7% yields respectively. The crude hemicellulose (40 gms.—4% KOH fraction) was soxhletted for 16 hours with 50% ethanol and then with absolute alcohol for 4 hours, when a milky white powder (25 gms.) was obtained (Methoxyl 2.1%; Carbonate ash 1.7%).

Hydrolysis of the above product with $2\text{NH}_4\text{SO}_4$ and neutralization with BaCO_3 furnished a neutral sugar fraction and the Barium-salt of an uronic acid. The latter yielded an uronic acid on being passed through Duolite C-25 cation exchanger. The former on paper chromatography indicated the presence of galactose, glucose, arabinose, xylose and fucose.

397. Low Temperature Carbonization of non-caking Coals from Raniganj Coalfield.

K. Y. SHRIKHANDE, H. C. CHAKRABARTI, H. S. BHATTACHARYA,
M. P. SINHA, T. K. BASU, K. BHADURI and N. N. DAS GUPTA,
Dhanbad.

Low temperature carbonization tests were carried out on high volatile non-caking Upper Kajora and Jambad Bawlah seam coals from Raniganj coalfield in the Gray King Apparatus and Fischer Assay equipment. Tests were also carried out on semi-pilot scale to study the effect of variation in temperature conditions on the quality and quantity (yields) of the various products of carbonization. The temperature of carbonization was varied between 500° and 715°C . The results show that the optimum yield of tar and quality of coke are obtainable by carbonizing these coals at 600°C as measured at the centre of coke mass.

Carbonization in an externally heated rotary retort (Fischer Assay) produced higher yield of tar but the quality of the coke deteriorated due to high content of fines due to degradation of the charge in the retort during the process of carbonization.

Correlations were found to exist between the laboratory assay (Gray King and Fischer) yields and semi-pilot-scale test yields. Correlations were also found between these yields and yields likely to be obtained in full-scale narrow vertical retorts. From the latter correlation the yields in large scale operation using these coals could be estimated.

398. Low Temperature Oxidation of Coal under Fluidized condition.

K. Y. SHRIKHANDE, A. K. DAS GUPTA and A. LAHIRI, Dhanbad.

Oxidation of coals at low temperature for formation of humic acids is a slow process requiring long period, i.e., 150-200 hours, for completion in fixed beds. The paper describes the studies carried out on low temperature oxidation of coals under fluidized condition in a 2" dia. inconel steel tube, two 4" dia. mild steel columns and a 1" dia. mild steel reactor for 2-3, 8-10 and 80-150 lb. batch charges respectively. Coals used for the studies were from Samla and Jambad Bawlah seams of the Raniganj coalfield, selected for their reactive nature, high moisture, volatile and oxygen contents and vitrainous appearance. Air was used as the fluidizing medium; it served as an oxidizing agent also.

The effect of the following variables upon oxidation was investigated: (i) particle size of coal, (ii) temperature of oxidation, (iii) flow rate of fluidizing and

oxidizing medium i.e., air, (iv) duration of oxidation, and (v) extraneous substances, such as water and nitric acid vapours, iron oxide scale and powdered alloy, "inconel".

From the studies it was found that oxidation improved with a decrease in particle size and increase in temperature of oxidation, flow rate of fluidizing and oxidizing medium, and duration of experiment, but there were limits for each of these experimental variables beyond which the effect would be adverse.

It appeared that the presence of iron oxide scale had a deleterious effect on oxidation. Although water and nitric acid vapours and inconel powder had beneficial effect on oxidation to some extent, the use of an alloy steel reaction vessels and with the adoption of optimum temperature and air flow rate, there was no need to moisten the fluidizing and oxidizing medium with water and/or nitric acid vapour or to use inconel powder for catalytic effect.

The period of oxidation for 70-90 per cent humic acids conversion with 70-80 per cent yield of the oxidized product has been reduced to 25-50 hours. As a result, the oxygen more than doubled in the final products for all runs in the three different reaction vessels.

The following have been found to be the optimum conditions for rapid oxidation :

- (i) The reactor should preferably be of a steel alloy viz. stainless, inconel, etc.
- (ii) The temperature of oxidation should be 200°C.
- (iii) The flow rate of air before entry into the reactor should be such that it gives a linear velocity of 0.2 f.p.s.
- (iv) For efficient operation in a particular reactor, proper weight of charge (governed by the height/diameter ratio) and its particle size distribution should be chosen.

399. Drying properties of the Oil of Momordica Dioica.

R. D. PATEL and L. F. RABARI, Vallabh Vidyanagar.

Drying properties of the oil of Momordica dioica polymerised at different temperatures without drier and with different concentrations of driers—cobalt naphthenate and manganese-naphthenate—are studied. Results are compared with those obtained when linseed oil was treated under identical conditions.

400. Effect of fertilizers on the I.V. and on the % of unsaturated acid contents of Bajari oils.

R. D. PATEL and U. S. PATHAK, Vallabh Vidyanagar.

Oils have been extracted from the fertilized Bajari grains and the properties viz, I.V., p.c. of Linoleic and Linolenic acids in the oils have been measured.

These values are found to increase or decrease with the type of the fertilizers used per acre.

401. Effect of fertilizers on the amylose p.c., chain-length and viscosity of Bajri Starch.

R. D. PATEL and U. S. PATHAK, Vallabh Vidyanagar.

Starch is extracted from Bajari grown with varying amount of fertilizers.

It has been observed that the percentage of amylose depends upon the fertilizers used. Chain-length and the viscosity of starch also found to depend upon the type of fertilizers used.

402. Coal Gas as a substitute for synthesis gas in the Fischer-Tropsch synthesis. Effects of compositions of nickel catalysts and working temperatures upon activity and product distribution.

G. C. BASAK and N. C. NIYOGI, Howrah.

The research work embodied in the paper refers to a systematic study on the possibility of the use of four nickel-based and cobalt-substituted nickel-based catalyst in the conversion of CO content of purified coal gas into the desired liquifiable hydrocarbons at atmospheric pressure and at temperatures varying between 180°C-200°C. For this purpose four nickel catalysts of different compositions were prepared. Each of these catalysts after reduction with H_2 at 400°C was used in the reactor for the synthesis reaction with previously purified coal gas at temperatures already mentioned. From the results of gas analysis it was shown that the nickel and substituted nickel catalysts promoted by MgO and ThO_2 produced higher catalytic activity at all these temperatures than those promoted by Al_2O_3 or MnO . The maximum yield of hydrocarbons amounting to about 90 p.c. of the theoretical value was obtained with catalysts 1 and 4 at 190°C.

INDUSTRIAL CHEMISTRY

403. Use of Safflower (*Carthamus tinctorius*) seed oil in hydrogenation industry.

M. M. CHAKRABARTY and M. K. CHAKRABARTY, Calcutta.

The refining and hydrogenation characteristics of safflower oil have been investigated and the analytical constants and the fatty acid composition with progress of hydrogenation has been determined. Results show that a Vanaspati comparable in quality to that prepared from groundnut oil can be manufactured easily. In general it was found that the hydrogenation characteristics of safflower seed is more or less similar to those of tobacco seed oil reported earlier (Proc. Ind. Sc. Cong., Pt. III, 1959). It is estimated that considerable savings can be effected in overall costs for the production of vanaspati from safflower oil although somewhat larger quantities of hydrogen may be necessary.

404. Preparation of Plastic fats by Directed Interesterification.

M. M. CHAKRABARTY, N. K. SEN and B. DAS, Calcutta.

Transformation of liquid fats to plastic fat by Directed Interesterification and without Hydrogenation has been studied on (1) Groundnut oil, (2) Sesame oil, (3) Safflower oil, (4) Neem oil, (5) Cotton seed oil, (6) Karela seed oil, and (7) Tung oil. Slip point rises of the following order was observed on the original oils :

Groundnut oil—34°C, Sesame oil—Nil, Safflower oil—5.5°C, Neem oil—12.5°C, Cotton seed oil—48.6°C, Karela seed oil—7°C, Tung oil—3°C.

The following indications were apparent from the investigation :

- (1) The chemical characteristics of the oils do not change.
- (2) The slip point of the whole fats increases slightly with the increase in the amount of catalyst.
- (3) Other factors, besides saturated acid content of the fat have bearing on the course of the reaction.
- (4) The nature, degree of unsaturation and the triglyceride composition influence the course of reaction to a great extent.

Use of interesterified Groundnut oil and Cotton seed oil in place of Vanaspathi to minimise the danger of atherosclerosis has been suggested. Segregation of oils into saturated and unsaturated fractions without recourse to solvents is another possibility.

405. Preparation of Soluble Tea.

A. S. BHADURI, M. M. CHAKRABARTY, N. K. SEN and B. N. CHAKRABARTY, Calcutta.

Attempts have been made for the preparation of soluble tea powder by spray drying the tea-infusion with and without other additives. Studies have been conducted on the conditions of (1) spray drying, (2) keeping qualities of the tea powder, (3) aromatic constituents of tea. It has been possible to prepare a powder, 0.5 gm. of which dissolved in water makes a cup of tea of average strength. Tea thus prepared does not contain all the aromatic principles which cannot be retained under the conditions of the spray drying. Attempts are being made (1) to improve the conditions of the spray drying to retain the major part of the aromatic constituents, (2) to recover the aromatic principles by condensation or adsorption from the out going vapours of the spray drier for subsequent addition.

406. Estimation of saturated fatty acids of a fat by bromination followed by urea adduction.

T. N. MEHTA, M. S. MURTY and P. M. MESHRAMKAR, Nagpur.

A new method of separating saturated fatty acids by brominating mixed fatty acids followed by removal of the saturated acids by urea adduction has been developed. It was found comparable to the Twitchell's lead-salt-alcohol and Bertram's oxidation methods with a definite advantage of obtaining saturated acids free from unsaturation.

407. Fractionation of rice bran oil fatty acids by crystallization with urea.

T. N. MEHTA and P. M. MESHRAMKAR, Nagpur.

Rice bran oil was extracted from bran of Balaghat (M.P.) area with hexane and its physical and chemical constants were determined. The mixed fatty acids were fractionated by liquid-solid countercurrent distribution with urea to find their composition which is as follows—Myristic 0.57%, palmitic 11.53%, stearic 2.44%, arachidic 7.42%, oleic 39% and linoleic 34.72%.

408. Extractive crystallization of the component fatty acids of karanja (*Pongamia glabra*) oil with urea.

T. N. MEHTA and P. M. MESHRAMKAR, Nagpur.

Karanja (*Pongamia glabra*) oil obtained locally was studied for its fatty acid composition. The non-glyceridic components, contributing orange colour and bitter odour, were removed by continuous liquid-liquid extraction of the oil at room temperature with methanol. The mixed fatty acids were fractionated by liquid-solid countercurrent distribution with urea alone, and in conjunction with lead-salt-alcohol separation. The percentage fatty acid composition of the oil is as follows—palmitic 3.66, stearic 7.10, arachidic 3.80, behenic 4.75, lignoceric 3.47, cerotic 1.39, oleic 44.54, linoleic 18.28, and eicosenoic 12.41.

409. Fractionation of peanut oil fatty acids by extractive crystallization with urea.

T. N. MEHTA and P. M. MESHRAMKAR, Nagpur.

Mode of distribution of the mixed, "solid", and "liquid" fatty acids of peanut (*Arachis hypogaea*) oil was studied by liquid-solid countercurrent distribution with urea. A similar distribution of the saturated acids (obtained on bromination of the mixed fatty acids, followed by urea adduction) was also carried out. Higher saturated fatty acids, free from unsaturation were obtained in the first two experiments, while a complete separation of the saturated acids, from the unsaturated ones, could be accomplished in the bromination experiment. The typical percentage fatty acid composition, calculated from these data, is as follows—myristic 0.67, palmitic 4.86, stearic 8.16, arachidic 2.80, behenic 3.97, lignoceric 1.53, oleic 51.69 and linoleic 26.32.

410. Fractionation of fatty acids of Indian kenaf seed oil with urea.

T. N. MEHTA and S. S. LOKRAS, Nagpur.

Kenaf oil was extracted with hexane from locally obtained seeds and its physical and chemical constants were determined. The mixed fatty acids were fractionated by liquid-solid countercurrent distribution with urea to assess their composition, which is as follows—stearic 8.22%, palmitic 15.38%, oleic 32.5%, linoleic 38.3% and epoxyoleic 5.6%. The proportion of saturated acids was verified by fractionating with urea the "solid" acids obtained by lead-salt-alcohol separation of the mixed fatty acids.

411. Chemical composition of the fatty oil obtained from seeds of *Eclipta prostrata*, Linn.

R. V. PATWARDHAN, V. G. SONAR and V. A. PATWARDHAN, Sangli.

Eclipta prostrata, Linn., known in Marathi as 'Maka' or 'Bhringuraja', is an annual plant belonging to the botanical family, Compositae, and is long known to have high medicinal value. The seeds obtained from plants grown in Sangli, were used for the extraction of the fatty oil. The fine powder of the seeds was extracted with ether from which a somewhat thick, dark green coloured oil was obtained to the extent of 13 per cent. On analysis the oil gave the following constants: Sp. Gr. at -28.5°C . 0.9221, Refractive Index at 29°C . ('Abbe') 1.4789; Acid V. 11.7; Sap. V. 209.9; Iodine V. (Wijs) 98.8; Acetyl V. 18.3; Reichert-Meissl V. 1.26; Polenske V. 0.31; Hehner V. 93.6; Unsaponifiable matter 3.5 per cent.

The mixed fatty acids yielded by means of the Twitchell's method 21.1 per cent. of solid acids and 78.9 per cent. of liquid acids. The composition of the liquid acids, determined by the bromination method, is the following: Alpha-Linoleic acid 28.1 per cent., isomeric linoleic acid 15.3 per cent. and oleic acid 56.6 per cent. The composition of the solid acids and the unsaponifiable matter is being studied.

412. Preparation of Road Tar from low temperature tar—Part I. Preparation of base pitch of Soft. Point $75 \pm 2^{\circ}\text{C}$.M. EHSAN, D. P. AGRAWAL, B. S. NARAYAN RAO, M. G. KRISHNA
and S. HUSAIN ZAHEER, Hyderabad-Deccan-9.

Laboratory investigations were conducted on air-blowing of low temperature tar produced from an internally heated low temperature carbonisation plant operat-

ing at Regional Research Laboratory, in order to obtain high yields of pitches of Soft. Point 75°C R & B and of low temperature susceptibility which are desirable properties in the pitch to be used as a base for road tar preparation. Air rates of $\frac{1}{2}$ —1 cft./lb./hr. were tried at 300°C and 250°C. The effect of stirring and addition of catalysts during air-blowing on the yield of, and on the duration required to get such a base pitch were studied.

It was found that adoption of higher temperatures and/or higher rates of air blowing reduced both the duration of air-blowing and the yield of base pitch and vice-versa.

There was no significant improvement on the duration of air-blowing when P_2O_5 or Mn. naphthenate were used as catalysts but $FeCl_3$ reduced the duration by 30% and also increased the yield.

It is possible to convert more than 90% of the L. T. heavy tar fraction to suitable base pitch for road tar by blowing air through it at 250°C, using an air rate of 1 cft./lb./hr. and 0.5% of $FeCl_3$ as catalyst.

413. Chemical examination of the oil from Rosa Bourbonica or Edward Rose.

M. C. NIGAM, G. N. GUPTA and D. R. DHINGRA, Kanpur.

The flowers of Rosa Bourbonica or Rose Edward commonly known as Cheenia or Desi Gulab are abundantly available in Uttar Pradesh. They are used for the preparation of Rose Water and Gulkand but small quantities are also used for making Rose Attar and Rose Oil.

The essential oil prepared from Rose Edward flowers was examined and various constituents present there in were identified using chromatographic method n. nonyl aldehyde, Citral, d-carvone, phenyl ethyl alcohol, l-citronellal, geraniol, citronellyl and geranyl formates and geranyl acetate were identified.

414. Studies in Gur Manufacture—A test for strike temperature in Gur manufacture.

A. J. DANGRE, Poona.

The strike temperature of sugar solutions of various purities are the boiling points of the saturated solutions. A method to determine this point in the case of Gur manufacture has been devised. This depends on the solubility of sucrose crystals exposed to the concentrating cane syrup.

415. Production of Butadiene from Ethanol by single step process.

N. D. GANGULY, B. N. AVASTHI and S. K. BHATTACHARYYA, Kharagpur.

The activity of a large number of catalysts for the single step catalytic conversion of ethyl alcohol to butadiene, has been systematically studied. Binary catalysts, comprising of dehydrating and dehydrogenating components, have been found to be more efficient than either single or ternary catalysts. Thorough investigations on the influence of temperature, alcohol feed rate, water content in the feed and the method of catalyst preparation on the yield of butadiene, have been carried out.

A mixture of Al_2O_3 and MgO in the ratio of 80 : 20 has been found to be the best catalyst. With this catalyst the process yield of butadiene obtained was 47.76% at an optimum temperance of 425°C, the alcohol feed rate being 1.875 c.c./hr./gm. of catalyst.

Binary catalysts like $\text{Al}_2\text{O}_3\text{-Cr}_2\text{O}_3$, $\text{Al}_2\text{O}_3\text{-Fe}_2\text{O}_3$, and $\text{Al}_2\text{O}_3\text{-CaO}$ were also found to be quite efficient.

The activity of the ternary catalysts like $\text{Al}_2\text{O}_3\text{-Cr}_2\text{O}_3\text{-MgO}$, $\text{Al}_2\text{O}_3\text{-Cr}_2\text{O}_3\text{-ZnO}$, $\text{Al}_2\text{O}_3\text{-MgO-ZnO}$, and $\text{Al}_2\text{O}_3\text{-NiO-Fe}_2\text{O}_3$, having various compositions was also investigated. But none of these catalysts responded favourably to this synthesis.

415A. Some Physical and Chemical Properties of Soda-Lime and Potash-Lime Silica glasses in which Lithia was substituted for Soda and Potash.

P. SEN and T. R. SAWHNEY, Banaras.

The determination of density and its calculated value according to Huggins, V_0 and its calculated value according to Huggins, and chemical durability were made on two series of glasses, the base glass composition being $6\text{ SiO}_2\cdot 0\cdot 05\text{Al}_2\text{O}_3\cdot 0\cdot 75\text{CaO}\cdot 1\cdot 2\text{Na}_2\text{O}$ and $6\text{ SiO}_2\cdot 0\cdot 03\text{Al}_2\text{O}_3\cdot 0\cdot 77\text{CaO}\cdot 1\cdot 2\text{K}_2\text{O}$. Na_2O and K_2O were replaced molecularly by Li_2O .

The batch was melted in fireclay pots in an oil-fired furnace giving a temperature of 1400°C , the crucibles were then cooled $2^\circ\text{C}/\text{min}$ to free from strain. Homogeneity and composition of the glasses were checked.

The density was determined by Archimedes method using distilled water as immersion liquid. The density was also calculated theoretically from Huggins formula. The value of V_0 containing 1 gm. atom of oxygen was calculated according to

$$V_0 = \frac{100}{d(\text{Pn}/\text{W})} \text{ and also from Huggins formula.}$$

The resistance of the glasses to the action of boiling water by grain test was expressed in terms of percentage loss in weight and mg. of sulphuric acid value for 100 gm. of glass.

The conclusions drawn are :—

1. The determined and calculated densities agree fairly well showing validity of Huggins formula

2. The V_0 values according to $V_0 = \frac{100}{d(\text{Pn}/\text{W})}$ and Huggins formula do not agree.

3. Soda glass is more resistant than potash glass.

4. Lithia when substituted for Na_2O or K_2O occupies smaller interstices than Na_2O or K_2O in the structure of glass, bonds the surrounding oxygen ions more tightly and decreases the density, V_0 value and improve the chemical durability.

APPLIED CHEMISTRY

416. Catalytic synthesis of methyl ester from ethylene, carbon monoxide and methanol.

S. N. NAG and S. K. BHATTACHARYYA, Kharagpur.

A comprehensive study has been made on the high pressure synthesis of methyl propionate from methanol, carbon monoxide and ethylene in presence of cobalt, nickel and iron iodide catalysts supported on silica gel. A temperature ranging from $200\text{--}350^\circ\text{C}$ and a pressure ranging from $2000\text{--}6000$ psi. were employed. Methyl propionate, propionic acid, acetone, propion-aldehyde, liquid polymer hydrocarbon, carbon dioxide, ethane, hydrogen and small amount of methane were the only products of reaction. The maximum yield of methyl propionate was obtained with 84.2 per cent cobalt iodide on silica gel as the catalyst

(Co : SiO₂ : : 50 : 50) using a temperature of 300°C, pressure of 1500 psi. (initial, applied at room temperature), 1 hour residence period, 10 ml. of catalyst and with a molar amounts of ethylene, carbon monoxide and methyl alcohol of 0.54, 0.97 and 0.50 respectively. The conversions under these conditions have been given.

Nearly 2—3 moles of ethylene were converted to polymer hydrocarbons •per mole of ethylene converted to methyl propionate.

417. Catalytic Synthesis of Ethyl propionate from ethylene, carbon monoxide and ethyl alcohol under high pressure.

S. N. NAG and S. K. BHATTACHARYYA, Kharagpur.

Detailed investigations on the catalytic synthesis of ethyl propionate from ethylene, carbon monoxide and ethyl alcohol have been carried out at the temperatures ranging from 180—300°C, and pressures ranging from 2000—8000 psi. in presence of various cobalt, nickel and iron catalysts either in the reduced form or as halides, both supported and unsupported. As catalyst supports, silica gel, pumice, kieselguhr, or kaolin were used. Besides, ethyl propionate, various by products including, propionic acid, propionaldehyde, liquid polymer hydrocarbons, carbon dioxide, ethane and hydrogen with traces of methane were formed : Cobalt iodide supported on silica gel (Co : SiO₂ : : 50 : 50) was established as the best catalyst for this synthesis. The optimum conversions of all the reactants to ethyl propionate occurred at a temperature of 230°C and initial pressure of 2500 psi. (Max. pressure—5900 psi.) using 3 hours residence period, 10 ml. of catalyst and a mole ratio of ethylene : carbon monoxide : ethyl alcohol : : 42 : 66 : 26.

The conversions to ethyl propionate and propionic acid under those conditions have been given.

In all the experiments nearly 1—2 moles of ethylene were wasted due to polymerisation to liquid hydrocarbon per mole of ethylene converted to ethyl propionate

418. Catalytic synthesis of ethyl propionate from diethyl ether and carbon monoxide under high pressure.

S. K. PALIT and S. K. BHATTACHARYYA, Kharagpur.

Detailed investigations on the high pressure synthesis of ethyl propionate from diethyl ether and carbon monoxide in presence of different nickel, cobalt and iron catalysts have been carried out. Catalysts such as the reduced metals, cobalt carbonyl and the halides of the metals supported on silica gel, pumice, kaolin or kieselguhr were used under a range of pressure of 175—360 atmospheres and a temperature range of 200—300°C. The halide catalysts were found to be the best and their activities were in the following order : iron > cobalt > nickel and iodide > bromide > chloride. Besides ethyl propionates as the main product, propionic acid, acetaldehyde, ethane, carbon dioxide were the by-products of the reaction. Traces of polymer products, methane, ethylene, ethyl iodide and ethyl alcohol were also produced in some cases. A temperature of 230°C, and a pressure of 230 atmosphere and a mole ratio of CO to ether as 3.5 to 1 (approximately) were the optimum conditions for the highest yield of ethyl propionate. With 5 ml. of iron iodide supported on silica gel catalyst (Fe : SiO₂ : : 50 : 50) under the above optimum conditions the yield of ethyl propionate was 28.2% on the input diethyl ether basis.

Of all the by-products propionic acid was obtained in large quantities in all the cases.

419. Catalytic synthesis of isopropyl isobutyrate from di-isopropyl ether and carbon monoxide under high pressure.

S. K. PALIT and S. K. BHATTACHARYYA, Kharagpur.

A comprehensive study on the high pressure synthesis of isopropyl isobutyrate from di-isopropyl ether and carbon monoxide in presence of nickel, cobalt and iron iodides supported on silica gel (Metal : SiO_2 : : 50 : 50) as catalysts has been made. These catalysts were found to be the best for the high pressure synthesis of ethyl propionate from propionic acid and carbon monoxide. The activities of the catalysts for this synthesis reaction were in the order : iron > nickel > cobalt. Besides isopropyl isobutyrate as the main product, isobutyric acid, isopropyl alcohol, acetone, carbon dioxide, propylene and propane were the by-products of the reaction. Traces of polymer products, propyl iodide and ethylene were also obtained in some cases.

A pressure of 250 atmosphere, a temperature of 230°C , residence period of 2 hours, ether to carbon monoxide mole ratio of 1 : 6 were the optimum conditions for the synthesis when 84.2% iron iodide supported on silica gel was used as the catalyst. Under the above optimum conditions, a yield of 12.8% on the input isopropyl ether basis to isopropyl isobutyrate was obtained. The optimum conditions of pressure and carbon monoxide to isopropyl ether ratio were 325 atmospheres and 7 : 1 respectively for cobalt iodide and nickel iodide on silica gel catalysts.

420. Synthesis of methyl acetate from carbon monoxide, methyl alcohol and methyl iodide under high pressure.

C. R. LAHIRI and S. K. BHATTACHARYYA, Kharagpur.

Reaction of carbon monoxide, methyl alcohol and methyl iodide in various mole ratios under variable conditions of temperature, pressure and residence period was studied with supported nickel iodide catalyst. Small amount of nickel hydroxide was added with the catalyst. The product contained a mixture of methyl acetate and acetic acid with traces of acetaldehyde. The reaction pressure was varied from 200 to 385 atmospheres, temperature from 158 to 252°C and the residence period from 1 to 3 hours. The molar ratio of carbon monoxide, methyl iodide and methyl alcohol was varied from 10.2 : 1.0 : 1.55 and 5.1 : 1.0 : 1.55. The optimum pressure and temperature were 325 atmospheres and 235°C respectively. The optimum molar ratio was 6.1 : 1.0 : 1.55 for optimum ester formation. The maximum process yield for ester was 12.63% in presence of 5 c.c. of catalyst under the optimum condition of temperature, pressure and mole ratio and at a residence period of 2 hours.

421. Synthesis of Acrylic esters from acetylene, carbon monoxide and alcohols under pressure.

A. K. SEN and S. K. BHATTACHARYYA, Kharagpur.

Synthesis of ethyl acrylate from acetylene, carbon monoxide and ethyl alcohol at high temperatures and pressures using supported as well as unsupported nickel iodide catalysts has been carried out. As reaction products, acrylic acid and traces of acetaldehyde were found to be present in addition to the main product, ethyl acrylate. The reaction was studied at a pressure range of 130 psi. to 250 psi. (initial pressure applied at room temperature), a temperature range of 100 – 185°C and at different mole ratios of C_2H_2 : CO : $\text{C}_2\text{H}_5\text{OH}$ varying from 1 : 1 : 0.97 to 1 : 1 : 3.88.

Using nickel iodide on silica-gel as the catalyst in the ratio of Ni : SiO₂ as 50 : 50, the optimum process yields of 55.77% and 23.76% of the ester based on acetylene and alcohol respectively were obtained at a temperature of 135°C, a pressure of 210 psi. and a residence period of 2 hours. The mole ratio of C₂H₂ : CO : C₂H₅OH was 1 : 1 : 2.35 for this optimum yield. •

422. Infant Food from Buffalo Milk. VI. Large scale production of roller dried infant food.

M. R. CHANDRASEKHARA, M. NARAYANA RAO, M. SWAMINATHAN,
D. S. BHATIA and V. SUBRAHMANYAN, Mysore.

A large scale production of infant food from buffalo milk was carried out using a roller drier. The important steps in the production of infant food by the roller process are (1) collection of milk of good quality (2) Reduction of fat content of buffalo milk to 2.5 per cent (3) pasteurization (4) addition of buffer salts to react with ionised calcium and thus to reduce the curd tension of the infant food (5) addition of cane sugar to adjust the protein content of the final product to about 22—24% and fat to about 14—16% (6) fortification with vitamins (7) homogenisation (8) drying and (9) powdering and packing. The solubility of the roller dried infant food prepared was found to be 84.9%. The curd tension of the reconstituted milk was quite low (3.5). The milk food used for feeding trials on infants.

423. Preparation of Bandhani (compounded) Asafoetida.

L. V. L. SASTRY, M. SRINIVASAN and V. SUBRAHMANYAN, Mysore.

Compounded asafoetida could be prepared by mixing small quantities of asafoetida and commonly available gums with or without wheat flour. Any of the gums like gum arabic, gum bebul, gum ghati, gum karaya or gum tolu could be used. The gum is first thoroughly mixed with an equal quantity of water, powdered asafoetida and wheat atta then added. The contents are well mixed. Addition of gum is found to facilitate quick setting of the product. During the process of setting, most of water evaporates (about 10 per cent moisture being left in the final product) and a hard mass simulating the marketed products in physical appearance and flavour can be obtained. As for the quantity of asafoetida to be used in blending, a *Hing* variety which is richest in odour is most fancied. Compounded asafoetida based on *Hingra* would be an economic proposition, because *Hingra* has a higher resin content (higher alcohol solubility), is a cheaper product and, if pure, can equal some of the best varieties of *Hing* in odour. Recently, we have had occasion to examine two pure specimens of asafoetida made available to us through the kind courtesy of the Afghan Government. The samples were semi-solids, milky white in appearance, comparatively free from mechanical impurities and had the characteristic odour of asafoetida, and from our analysis could be reasonably classified as *Hingra*.

Approximate cost of production of compounded asafoetida and its relation to the marketed price will be discussed.

424. Cystine as addition agent for bright zinc plating from acid bath.

A. JOGARAO and S. GURUVIAH, Karaikudi.

The present paper reports the results of successful bright zinc plating obtained from the use of certain addition agents in acid zinc baths. Many substances, such

as brucine, fumaric acid, cytyl trimethyl ammonium, bromide, sulphanilamide, cystine, ammonium bifuoride and hexamine have been tried in the acid zinc bath, but only hexamine and cystine have given the most satisfactory results. Of the two cystine gave much better results. The investigation included experiments in the Hull cell for determining the optimum condition of current density and concentration of the addition agents. Plating trials in the usual electrolytic cell confirmed that the best condition for production of bright zinc plating from acid zinc sulphate-chloride bath were c.d. 80—140 A./s.f., concentration of addition agents (cystine 1—2 g/l., or hexamine (4—8 g/l.). The brightness of the plate was evaluated by Beckmann spectrophotometer measurements. Microscopic examination of both the bright and matte deposit was also attempted. The bright deposits appeared to be satisfactory in respect of adhesion and freedom from pinholes.

425. Hexamine as addition agent for bright nickel plating.

A. JOGARAO and S. GURUVIAH, Karaikudi.

Production of bright plating of metals direct from the vat has much to commend itself for obvious reasons. Several brightening agents have been reported in the literature during the last twenty years for bright plating of nickel. The present paper relates to certain promising results obtained in the use of hexamine as an addition agent for direct bright plating of nickel from the conventional Watts bath. The best conditions for the production of bright nickel plate have been arrived at. The experiments included investigations using the Hull cell, comparative evaluation of the brightness of the plate through Beckmann spectrophotometric measurements of the diffuse reflectivity, microscopic and electron microscopic examination of the matte and bright plates produced under different conditions. The work is being extended to the use of certain other addition agents not yet reported in the literature. Some of the results obtained in the use of cystine, fumaric acid and sodium nitrite indicate promising possibilities.

426. Corrosion of metals in terms of the free electron cloud in metals.

K. S. RAJAGOPALAN, P. B. MATHUR, Karaikudi-3.

The corrosion tendency of metals is interpreted in terms of electron atmosphere parameters of metals in the solid state. This has led to an arrangement of metals, which is, apparently, more in accordance with the corrosion behaviour.

427. Effect of certain stabilizers on the deposition of rubber latex on Plaster of Paris Moulds.

(KUMARI) S. M. BORKAR, A. S. GHAG and M. B. KABADI, Bombay.

The authors have studied the effects of gum arabic, glue, gelatin, resin and saponin on the rate of deposition of rubber latex on the moulds prepared from Plaster of Paris.

It is found that the concentration of the stabilizer needed for confirming stability on latex was 0.5 per 100 parts of dry rubber or more in case of saponin and 0.1 or more for gum, glue, gelatin and resin. The thickening effect of the stabilizers on latex thus preceded these concentrations.

428. Sulphonation of Coal. Influence of prior oxidation of coal with chemical reagents on ion exchange activity.

DIGBIJOY DATTA,

Effect of prior oxidation of coal of two grades by chemical agents like KMnO_4 and HNO_3 on the development of ion-exchange property after sulphonation has been studied. It has been found, that with only a bit of regard to the degree of maturity of the carbonaceous material, the extent of ion-exchange capacity developed falls, in general.

429. Chemical Examination of the Essential Oil derived from the leaves of *Murraya koenigii* (Linn.) Spreng. (Indian curry-leaf).

R. M. PUROHIT and S. S. NIGAM, Sagar.

The essential oil of *Murraya koenigii* Spreng has been obtained by water distillation of the fresh leaves in a yield of 1% as a bright yellow mobile liquid having the following physical and chemical constants:—

Specific gravity at 25°	=0.8589
Refractive index at 25°	=1.4706
Optical rotation in CHCl_3 (25°)	= -36° 14'
Acid value	=1.17
Saponification value	=8.18
Saponification value after acetylation	=52.81

Unlike the essential oils obtained previously by Penfold and Simonsen from dry leaves and Dutt from fresh leaves using steam under pressure, this oil was found to have a higher optical rotation and the following percentage composition, consisting of a greater percentage of simple monocyclic and bicyclic terpenes and a lesser percentage of sesquiterpenes, as compared with the essential oil obtained by using steam under pressure. The oil had also better olfactory properties and is thus better suited for being used in the perfumery and allied industry.

1- α -Pinene	...	...	...	27.3%
1-Sabinene	...	...	...	34.0%
Dipentene	...	...	...	15.9%
1- α -Terpineol	...	...	...	7.7%
1- α -Caryophyllene	...	...	...	6.7%
1-Cadinene	...	...	...	5.2%
Residue (unidentified)	...	...	...	3.2%

430. Differential Thermal Analysis of some Indian Limestones.

ABDE ALI and B. V. S. SUBBA RAO, Hyderabad.

The occurrence and extent of deposits of 13 Indian limestones are given. The mineralogical composition of limestones are calculated from the chemical analysis and the data thus obtained are co-related with the results of the DTA., carried out on the limestones as well as on some pure standard carbonate minerals of known composition. Based on the mineralogical composition, suggestions are given for the proper utilization of the limestones,

431. Addition agents in the electrodeposition of bright zinc plate.

B. S. R. SASTRI, Karaikudi.

From both cyanide and acid baths, the zinc plating obtained is rather dull in appearance and efforts have constantly been made to produce bright and shining deposits direct from the bath by the incorporation of certain addition agents.

Adopting a conventional cyanide bath and purifying it, various addition agents were tried as brighteners: molybdic acid, coumarin, ammonium vanadate, selenium dioxide, thio-urea, sodium tungstate, manganese sulphate, potassium thiocyanate, fumaric acid, brucine and a mixture of alcohol, glycerine and dextrin. Of these coumarin, manganese sulphate and the mixture of alcohol, glycerine and dextrin gave a comparatively better finish. The effect of the concentration of the addition agent used and of the current density was studied. In most cases the plate after removal from the cyanide bath had to be given a bright dip. Certain indicator dyes like thymol blue, bromophenol blue and bromocresol purple and surface active agents like Teepol were also found to be effective brightening agents.

For acid zinc plating, β -naphthol, sodium bisulphite, caffeine, thio-urea, fumaric acid and brucine were tried as addition agents for obtaining bright zinc plate. The zinc deposits were found to be milky white to lustrous white in appearance unlike the bluish white bright plate from the cyanide bath.

432. Preparation of Road Tar from low temperature tar—Part II. Blending of Airblown low temperature pitches with low temperature tar oil fractions.

B. S. NARAYAN RAO, D. P. AGRAWAL, M. EHSAN, M. G. KRISHNA and S. H. ZAHEER, Hyderabad.

Laboratory-scale investigations on blending of air-blown and catalytically air-blown low temperature coal tar pitches of softening point 69–77°C (R & B) with blending agents such as the heavy tar (I), the 300–355°C fraction thereof (II), and the +300°C (III) and the 300–355°C (IV) fractions of neutral oil from light tar, are reported. The compatibility and the decrease in the softening points of the pitches when mixed with different proportions of the blending agents were studied. It was found that (I) was compatible with all the pitches while (IV) was not compatible at all. (II) and (III) were not compatible with pitches prepared by air-blowing of heavy tar with P_2O_5 and $FeCl_3$ as catalysts. The reduction in the softening point of the pitches when they were blended with I, II and III was 1.2–2.6°C, 5–6°C and 4–5°C respectively for every 10% addition of the blending agent.

NUCLEAR CHEMISTRY**433. Deuteration of Biphenyl.**

D. C. GAMI, S. D. PAUL, and A. S. RAPIAL, Trombay.

A project has been initiated with the objective of preparing deuterated organic compounds which can be used moderators in natural uranium fuelled nuclear reactors and which could be produced economically on an industrial scale. Amongst the various organic compounds proposed, it is known that biphenyl, terphenyl and their mixtures are most promising as moderators. This paper presents the data obtained for the preparation of deuterated biphenyl.

After exhaustive literature survey and investigation of different methods for the preparation of deuterated biphenyl it was decided to investigate experimentally

direct deuteration of biphenyl by heavy water using a suitable catalyst. Seven different catalysts were tried at different temperatures, different catalyst concentrations and different biphenyl to heavy water ratios. Data obtained are presented in tabular form. From this data it is evident that nickel T-4 and platinum black are found to be the most promising catalysts.

Work is now being pursued to improve the activity of these catalysts and to try these catalysts for the preparation of deuterated terphenyl and mixture of biphenyl and terphenyl.

434. Coseparation of Thorium (UX_1) with Calcium Oxalate.

B. C. PURKAYASTHA and S. N. BHATTACHARYYA, Calcutta-9.

In a previous communication (1) the uptake of rare earths by calcium oxalate has been described. It has been shown that calcium oxalate dihydrate takes up rare earths through mixed crystal formation. This investigation deals with the uptake of thorium by calcium oxalate. In this case also it has been found that calcium oxalate dihydrate carries thorium through mixed crystal formation. In case of mono- and tri-hydrate the uptake follows a Freundlich adsorption isotherm. It is of interest to note that the uptake of thorium (UX_1) however differs in one important aspect that calcium oxalate when precipitated by slow hydrolysis of ethyl oxalate no concordant λ value, as was the case with rare earths, was observed. The λ values were, however, found constant when calcium oxalate was precipitated by the addition of oxalic acid. Conclusion has, therefore, been arrived at that an unstable form of thorium oxalate plays the role in the display of mixed crystal formation. Failure in the evidence of mixed crystal formation in slow hydrolysis is probably due to the fact that the unstable form of the guest component breaks up before another plane of the host lattice arrives to give it a covering protection. It is therefore a strong evidence that unstable morphological species of the guest may play the role in this type of anomalous mixed crystal formation. Hahn's so called anomalous mixed crystal has therefore been argued to be a normal state of affairs in this submicro concentrations. The range of mixed crystal formation in this system has been studied. The chemical composition of the guest has been discussed in the light of these observations.

(1) B. C. Purkayastha & S. N. Bhattacharyya, *J. Inorg. Nucl. Chem.* **10**, 103 (1959).

435. On the study of the coseparation of thorium and rare earths with calcium sulphate on a tracer scale.

B. C. PURKAYASTHA and S. N. BHATTACHARYYA, Calcutta-9.

In a previous communication (1) the uptake of europium on a tracer scale with Eu^{152} and 154 was reported. This study has been extended to thorium and other rare earths with the help of UX^1 , Ce^{144} , Pm^{147} and Y^{91} as radioactive indicators. It has been found that thorium and all other rare earth tracers are taken up through mixed crystal formation by an unstable form of calcium sulphate which later turns out to stable monoclinic gypsum. The range of mixed crystal formation in all these cases is, however, very narrow. When the concentration of the tracer ion exceeds that range, the uptake obeys an adsorption isotherm. It has been found that the presence of one rare earth, say, cerium (inactive) just beyond the range of mixed crystal formation causes the uptake of another rare earth, say, europium (in ultramicro concentration) to obey Freundlich adsorption isotherm. This fact throws light on the morphological analogy of the rare earths amongst one

another even in such tracer concentration. Yttrium and thorium, however, differ in this respect. Tracer amounts of europium have thus been found to be taken up by calcium sulphate through mixed crystal formation even in the presence of yttrium and thorium, the concentrations of which are taken in the range beyond the limit of mixed crystal formation. From these facts it has been argued that Hahn's so called anomalous mixed crystal is due to breeding up of unstable morphological species of the guest by the host component where concentrations of the guest play the important role. It has further been argued that Khlopkin's observation as regards the uptake through the formation of molecular mixed crystals and Hahn's study on the so called anomalous mixed crystals can be correlated. A comparative study of the λ values of different rare earths gives a clear evidence that mixed crystal formation in these cases is not through double salt formation as was anticipated by Hahn in his study of similar nature.

436. On the study of the indirect application of radioactive nuclei in analytical chemistry. Part II.

B. C. PURKAYASTHA and M. N. CHANDRA, Calcutta-9.

Use of radioactive nuclei in analytical chemistry has been discussed in some details in a previous communication. The present investigation deals with the application of co-ordination compounds to extend the use of I^{131} , an easily available isotope of convenient half life, in the determination of mercury and cadmium. The principle employed is to add excess of labelled iodine as KI to neutral solution of mercury and cadmium to which is then added a solution of copper ethylene diamine sulphate in slight excess. The precipitate is then allowed to settle and activity of a portion of the solution is measured with a liquid counter. The loss in activity is a measure of mercury or cadmium as the case may be. Cadmium and mercury from 50 mg. to 0.1 mg. have thus far been estimated. The data lies always within statistical fluctuations. It can therefore be claimed to be a very quick and reliable method for the estimation of mercury and cadmium even in very small concentration as mentioned above.

437. On the study of rare elements in Indian Coal.

B. C. PURKAYASTHA and S. R. SAHA, Calcutta.

Importance of the study of rare elements in Indian coal ash has been discussed. The present paper deals with the development of a method of quantitative extraction of sub-microgram of uranium present in coal ash to be estimated by a fluorimeter. A simplified procedure which gives accurate findings, has been worked out. Uranium content of coal ash of Lakurka colliery at two depths has been estimated. It has been observed in this particular case that the uranium content decreases as the depth increases. Uranium present per gm. of the ash at depths 220 ft. and 385 ft. are respectively 4×10^{-6} gm. and 2×10^{-6} gm. The possible causes of the variation of uranium content with depth have been discussed.

438. On the study of the waters of the hot springs of Bakreswar.

B. C. PURKAYASTHA and M. GANGULY, Calcutta.

Various methods on the quantitative extraction of uranium from mineral waters to be estimated by a fluorimeter has been examined. A simplified procedure which

guarantees dependable recovery has been developed. The technique has been applied to the determination of submicro amount of uranium present in all the major five hot springs of Bakreswar. The major constituents of one of these springs (Khar Kundu) have also been estimated. In spite of the wide temperature variations of these springs (from 67°C to 46°C), it has been found that the uranium content (1.2×10^{-7} gm./litre of water), the chloride content (37 mgs./litres of water) and the pH (9.3) of these major springs are near about the same. It has been argued that these springs must be the offshoots of a mother spring lying underground. It is interesting to note that there is seasonal variation in uranium contents in these springs. This seasonal variation has been discussed in the light of the subterranean causes.

439. An Investigation on Some Radiochemical Precautions in Lower Level Tracer Work.

FAZLE HOSAIN and SUBHAS R. BASU, Calcutta.

The present investigation represents studies on some radiochemical precautionary measures in solid sample counting specially in low level tracer work. Shape and natural contaminations in the planchets, loss of radioactivity during drying and the effect of added carrier, presence of moisture etc. have been studied mainly with reference to tracer work with I^{131} using a gas-flow counter with anti-coincidence ring. In certain experiments if such precautionary measures are not taken then it is likely to give completely erroneous results.

440. Gamma Dosimetry at 'Apsara', the Swimming Pool Reactor of the Atomic Energy Establishment Trombay.

A. S. GHOSH MAZUMDAR and R. N. SINGH, Trombay.

Gamma dose rates obtainable in the Apsara tank have been determined by chemical dosimetry using (i) ferrous sulphate in 0.8 N H_2SO_4 , (ii) ferric brown (ferric complex of orthophenanthroline) in 0.01 N H_2SO_4 , and (iii) ceric sulphate in 0.8 N H_2SO_4 . These determinations have been made at varying power levels of the reactor, and also at varying distances from the reactor core surface along the vertical plane perpendicular to and at the middle of this surface. The maximum dose rate has been found as expected at a depth corresponding to the midpoint level of the core. As the horizontal distance from the core surface increases from 3 cm. to 155 cm., the dose rate falls from about 2×10^{18} to 3×10^{14} ev/ml/hr/KW.

441. A study of the dissolution of Irradiated Uranium for quantitative recovery of Br^{83} .

M. V. RAMANIAH, M. N. NAMBOODIRI and K. RENGAN, Trombay.

Neutron irradiated uranium metal was subjected to different techniques of dissolution. It was found that Br^{83} formed in fission can be quantitatively isolated by dissolution in hydrochloric acid in a 'closed system' both in the presence and absence of bromide carrier and in an 'open system' in the presence of bromide carrier.

442. The Aqueous Chemistry of Americium (III) : Chloride and Nitrate Complexes.

H. D. SHARMA and P. K. KHOPKAR, Trombay.

The nature of the Americium III species existing in the aqueous solutions has been investigated by means of a two phase distribution equilibrium. The americium is partially extracted into benzene as the neutral chelate of thenoyl tri-fluoro acetone, $\text{Am}(\text{TTA})^3$ in 1M ammonium perchlorate at 25°C. The distribution coefficients variation with pH shows that the species in solution is Am^{+++} up to a pH of 3.5 and possibly AmOH^{++} in the pH range of 3.5 to 4.

The stability constants of nitrate and chloride complexes formed were determined in 1M ammonium perchlorate solution. The equilibrium constant for the chloride complex AmCl^{++} at ionic strength of 1 is 2.24 whereas that of AmNO_3^{++} is 2.46.

443. Primary separation of Plutonium by Tri-n-Butyl Phosphate Extraction.

H. D. SHARMA, M. V. RAMANIAH, K. RENGAN and K. B. SHAIH, Trombay.

A study of some of the important factors affecting the extraction of plutonium (IV) by tri-n-butyl phosphate for the primary separation of plutonium following the purex process has been undertaken to provide operating data for the Reprocessing Plant to be built at Trombay.

The partition coefficients of plutonium (IV) in nitric acid were measured as functions of (i) concentration of nitric acid, (ii) concentration of TBP and (iii) the concentration of uranium. These experiments have shown no serious disagreement with the literature data, and that the locally available kerosene can be used as diluent.

444. Large scale purification of Plutonium by Anion Exchange.

H. D. SHARMA, A. S. GHOSH MAZUMDAR, P. R. NATARAJAN,
K. NEELAKANTAN and M. S. SUBRAMANIAN, Trombay.

This work has been undertaken as part of the development work to collect chemical data for the design of the Reprocessing Plant to be built at Trombay. Use of anion exchange resins is envisaged for the purification of plutonium. The following data have so far been obtained with two resins, *viz.*, Deacidite FF and Amberlite IRA-400 and compared with similar data published in the literature :—

- (a) variation of the distribution coefficients (K_d) as a function of nitric acid concentration for both uranium (VI) plutonium (IV);
- (b) K_d of plutonium (IV) in the presence of different mixtures of sulphates, nitrites, iron and sodium salts;
- (c) adsorption, break-through and elution behaviour in a column with Deacidite FF, whose elution behaviour is superior to that of the Amberlite resin, at room temperature and at 60°C;
- (d) elution characteristics using the following three eluting agents; (i) 0.5 M nitric acid at room temperature as well as at 60°C; (ii) 0.5 M nitric acid mixed with hydroxylamine and (iii) 0.5 M hydrochloric acid,

445. Extraction of Uranium by Tri-n-Butyl Phosphate.

H. D. SHARMA, M. V. RAMANIAH, M. N. NAMBOODIRI,
P. K. BHATTACHARYYA and D. V. SINGH, Trombay.

The extraction of uranium by tri-n-butyl phosphate has been studied* under conditions of interest in the Purex process for reprocessing reactor fuels. The variation of uranium partition coefficients with nitric acid concentration of the aqueous phase, temperature and saturation of TBP with uranium have been measured. Extraction of nitric acid has been studied. Exact agreement with data available in literature was not found but the general trends were the same.

446. The Nitrate Complexes of Plutonium IV in Methyl Isobutyl Ketone.

H. D. SHARMA and T. S. LAXMINARAYANA, Trombay.

The absorption spectrum of Pu (IV) in methyl isobutyl ketone resembles the one obtained by Hindman for plutonium (IV) in the aqueous solution in 11 M nitric acid which has been attributed to the anionic species $\text{Pu}(\text{NO}_3)_6^-$.

Distribution coefficients of plutonium (IV) into hexone have been measured as a function of the concentration of hexone in an inert diluent xylene. The log plot of the distribution coefficient against the concentration of hexone gives a slope of 3 indicating that the plutonium species in the organic phase is attached to 3 molecules of hexone.

Distribution coefficients of plutonium (IV) between hexone and nitric acid solutions have been determined at varying nitrate ion concentrations. It has been found that in the range 3 to 7 M nitrate ion the distribution coefficient is proportional to the power 1.4 of the nitrate ion concentration. Similar experiments at constant nitrate ion concentration at varying hydrogen ion concentration show that the distribution coefficients are practically the same over a range of 2 to 5 M hydrogen ion concentration.

447. Preparation of Carrier-free Cs^{132} by Multiple Neutron Absorption.

K. S. BHATKI, K. P. GOPINATHAN and S. JHA, Bombay.

The formation of Cs^{132} ($t_{1/2} = 6.2\text{d}$) by the irradiation of BaCO_3 with the large flux (10^{14} neutrons $\text{cm}^{-2} \text{sec}^{-1}$) of neutrons in DIDO, Harwell, has been proved. A radiochemical separation of the cesium activities in the carrier-free form and examination of the gamma-ray spectrum in a NaI(Tl) scintillation spectrometer showed the presence of the well-established gamma-ray of energy 670 KeV from Cs^{132} in addition to the K X-rays from the electron-capture decay of Cs^{131} .

Cs^{132} is formed by the multiple neutron capture-reaction $\text{Ba}^{138} (n, \gamma) \text{Ba}^{131} \xrightarrow{\text{E.C.}} \text{Cs}^{131} (n, \gamma) \text{Cs}^{132}$. This method has been used for the preparation of carrier-free Cs^{132} for nuclear spectroscopic work.

448. Production of high specific activity isotopes of Promethium from Pile-irradiated Neodymium.

K. S. BHATKI, K. P. GOPINATHAN and A. T. RANE, Bombay.

Promethium isotopes Pm^{147} ($t_{1/2} = 2.65 \text{ y}$), Pm^{148} ($t_{1/2} = 54 \text{ hr}$) and Pm^{151} ($t_{1/2} = 27.5 \text{ hr}$) are normally produced on thermal neutron irradiation of ordinary Neodymium. Pm^{146} ($t_{1/2} = 5.3 \text{ d}$ and 42 d) was produced by former workers by

irradiation of separated Nd^{148} with 12 MeV proton. In the present work Pm^{148} has been produced by irradiation of ordinary neodymium with the high flux of neutrons in

DIDO, Harwell. The Pm^{148} was formed thus : $\text{Nd}^{148} (n, \gamma) \text{Nd}^{147} \xrightarrow{\beta^-} \text{Pm}^{147} (n, \gamma) \text{Pm}^{148}$. Promethium was separated from the neodymium and all other contaminating activities by adsorption on a Dowex-50 ion-exchange column and elution with 0.5 M lactic acid at an adjusted pH, at room temperature. For shorter-lived isotopes a pH 4.2 was used for quick separation, and for longer-lived isotopes a lower pH 3.5 was used to ensure a well-defined separation. The activities were examined by a scintillation counter and the radio-chemical purity was ascertained by examining the gamma-ray spectrum in a NaI (Tl) scintillation spectrometer.

449. Deuteration of Biphenyl.

D. C. GAMI, S. D. PAUL and A. S. RAPIAL, Trombay.

A project has been initiated for the preparation of deuterated organic compounds which can be used as moderator in natural uranium fueled nuclear reactors and which can be produced economically on an industrial scale. Amongst the various organic compounds proposed, it is known that biphenyl, terphenyl and their mixtures are most promising as moderators. This paper presents the data obtained for the preparation of deuterated biphenyl.

After exhaustive literature survey and investigation of different methods for the preparation of deuterated biphenyl it was decided to investigate experimentally direct deuteration of biphenyl by heavy water using suitable catalyst. Seven different catalysts were tried at different temperatures, different catalyst concentrations and different biphenyl to heavy water ratios. Data obtained are presented in tabular form. From this data it is evident that nickel T-4 and platinum black are found to be most promising catalyst.

Work is now being pursued to improve the activity of these catalysts and to try these catalysts for the preparation of deuterated triphenyl and mixture of biphenyl and triphenyl.

450. Chemical methods for decontamination of low level mixed Alpha active effluents.

P. R. KAMATH, A. L. MOHAN, S. R. L. NARAYANA and R. V. AMALRAJ, Trombay.

The discharge of alpha active low level effluents to public waters is done under very stringent limits for the activity level. The currently practised methods of decontamination of these liquid wastes before discharge is to subject them to chemical treatment and then to pass the processed effluent through ion exchange columns as and when the chemical treatments alone did not give the necessary decontamination. In a detailed study of alpha decontamination at Harwell, the alpha activity was carried down on single stoichiometric carrier precipitations such as of calcium phosphate, calcium-tannate or ferric sulphide and the processed effluents were passed through Vermiculite columns to obtain the necessary final decontamination.

In the present work alpha active effluents not containing complexing or chelating agents, from the radiochemical laboratories in Trombay were used for decontamination by chemical methods. In this, multiple chemical precipitations are effected in a single process to bring down the alpha activity in a co-precipitated

or adsorbed form. In a typical method the effluent activity is reduced by iron filings and then treated with calcium nitrate as carrier in excess and tannic acid at pH 2. A combined precipitate of calcium tannate and phosphate are formed by bringing the pH to 9 with sodium phosphate. The pH of the solution is then brought down to about 8 by the addition of ferric alum solution. In the process iron hydroxy phosphates are precipitated. Thus the tracer activity is brought down in stages by progressive co-precipitation.

The methods show that under the conditions of the levels of effluent activity handled ($\sim 10^{-6}$ uc/ml), chemical treatment alone could effect decontamination to levels below 10^{-6} uc/ml.

451. Radiation annealing by X-rays in Szilard-Chalmers reaction with Tris Acetylacetone Cobalt (III).

JAGDISH SHANKAR and K. S. VENKATESWARLU, Trombay.

X-irradiation of the thermal neutron irradiated tris acetylacetone cobalt (III), indicated that radiation induced increase in retention is exponential. It was also observed that those species amenable to radiation annealing decrease with the time of storage after neutron irradiation. The extent of radiation induced recovery is of the order of 40% of the damage, if x-irradiation is carried out immediately after neutron bombardment.

SECTION OF GEOLOGY AND GEOGRAPHY

President :—DR. V. S. DUBEY, M.Sc., Ph.D., D.I.C.

Abstract

A. GEOLOGY

General

1. Geologists and Radioactive Age Determination.

M. V. N. MURTHY, Calcutta.

Numerous isotopic age determinations have been published recently, especially in North America, by uranium, thorium/lead ratios on zircon, and by potassium/argon and rubidium/strontium ratios on biotite and potash feldspar. Discordance in the ages calculated from U/Pb and Th/Pb ratios on the same mineral may be due to fractionation of lead isotopes because of their differing bond strengths in minerals. Discordance between U/Pb ages on zircons and K/A and Rb/Sr ratios on biotites from the same rocks suggests more than one igneous and/or metamorphic periods. Systematic regional age determinations of rocks will reveal such episodes, otherwise not obvious in the field and may thus set the geologist back to the field to check up geology. The choice and collection of the samples for age determinations must be made by the geologist after due considerations to the geology. Zircon is especially useful as a geological tracer. The interpretation of the age data must also be made by the geologist. The writer pleads for co-ordinated intensive age-determination-projects, with full co-operation of the physicist and the geologist. Without critically evaluated age data, it will be impossible to decipher the complex geological history of the vast unfossiliferous terrain of peninsular and extra-peninsular India.

2. A Study of Bijawars in Jabalpur District, M.P.

V. S. DUBEY and UMA SHANKER, Banaras.

The present paper contains the result of the study of Bijawars in Jabalpur District, around Sihroa Tahsil and also comparison of traps occurring in this area with other traps like Gwalior. The Bijawar series here comprises of chlorite-schist, quartzites, phyllites, shale, hematite-quartzite and intruded basic Bijawar traps.

Chlorite-schist consists of chlorite, biotite, feldspar and epidote. The dimensions of chlorites vary in size from 1 mm. to 1.5 mm. The extinction angle in some crystals is parallel to cleavage, but in other it is about 5°. It is possible that this chlorite-schist may belong to an older formation. This seems to have been formed by the metamorphism of basic igneous rocks.

Quartzites are decomposed and are often cemented together, as it were, by a matrix of manganese and iron ore. The hardness is 5—6 and its specific gravity is 2.5. The typical mosaic texture is seen which is the result of secondary growth, rather than result of secondary crystallisation of quartz grains. The quartz grains

are arranged in bands. The banded structure may have resulted from the formation of quartzite under stress.

Meta-crysts 1.5 to 2 mm. long of ilmenite are well-developed in shale showing dark brown colour with extremely high birefringence.

Hematite-quartzite, is hard, compact and shows folding structure. Folding is seen in some hand specimen. Specific gravity is 4.5 to 5.1. This hematite-quartzite has given rise to iron ores of this area, as well as to small manganese deposits by the leaching out of Silica.

A sill of the basic rock is found intruding in the Bijawar rocks and is running NW-SE direction. The sill is decomposed on the surface.

The rock is fine to medium grained in texture, greenish black, compact and traversed by epidote veins. The feldspar crystals are much altered. The hornblende crystals are segregated in a linear fashion and have developed some degree of schistosity. The specific gravity varies from 2.9 to 3.03.

From the detailed field and laboratory study of these rocks and from its comparison with other Bijawar areas it has been suggested that this formation belongs to Bijawar age and not to Dharwar, as has been assumed by some writers.

3. A note on the rocks of Alagdiha—Baliapur area, Dhanbad.

Y. K. AGRAWAL, and K. V. V. SATYANARAYANA MURTY, Dhanbad.

The following geological succession of the Archaeans of Alagdiha-Baliapur area (Toposheet 73 I/6 and 73 I/10 Lat. $23^{\circ} 42'$ to $23^{\circ} 45'$ and long. $86^{\circ} 27'$ to $86^{\circ} 33'$) has been worked out.

Pegmatites and Quartz Veins

Metamorphosed or Metasomatised Basic Intrusives.	{	Epidiorites, Meta-dolerites and Meta-norites.
Older schists and gneisses		Hornblende gneiss, Augen gneiss, Amphibolites, diopside granulites, Quartzites, felspathic gneisses and mica schists.

Older schists and gneisses which form the country rock have suffered different stages of metamorphism. The basic intrusive rocks show very good example of felspathisation represented by biotite rich epidiorites, biotite garnet rich epidiorites and epidiorites bearing rapakivi like structures. The ovoids of feldspars found in the latter are variable in shape and size. One such ovoid measures 6 inches \times 2 inches. The olivine meta-norites show sub-ophitic to ophitic texture and occur in small patches. Reaction rims around olivine similar to those described by Agrawal from Hirapur area are common. The plagioclase of these rocks show intense clouding.

4. Photogeologic Techniques.

V. VENKATESH, Calcutta.

Techniques for obtaining geologic information from aerial photographs have been greatly developed and refined in recent years. Analyses of drainage, fracture and lineament patterns on photographs and recognition of local anomalies in these indicate probable oil structures. Experimental studies in the U.S.A. with colour

photography, use of filters, radar and infra-red photography indicate their usefulness in recognition of alteration haloes, geologic contacts etc. Ortho-photos will further facilitate the use of aerial photos as base maps.

Photogeologic mapping is faster and more economical than field mapping. Arid climate, sparse vegetation, mature drainage and sedimentary rocks are some of the factors particularly favourable for photogeologic studies. Quantitative geologic data like dip of beds, slope, thickness of strata and construction of stratigraphic column and geologic cross-sections are easily and quickly obtained from the aerial photos by means of simple instruments. The technique is particularly suitable for areas like the Himalaya where working season is short and access difficult. However, no photogeologic map is complete without field checking and photogeology cannot wholly replace field mapping.

Photogeologic studies are useful in such diverse problems as search for oil structures, mineral prospecting, location of construction sites and material, water resources studies etc. Thus, photogeology will greatly aid and speed up the various geologic investigations being undertaken for speedy industrialisation of the country. It is a rapidly developing technique and should be introduced in the curricula of our universities.

5. **Origin of the Indian Peninsula.**

MIHIR KUMAR BOSI, Calcutta.

The present peninsula has grown gradually by repeated process of orogenesis and marginal accretion and quiescence of the mobile belts as parts of the craton, causing the platform to expand. The nucleation was caused by a volcanic activity in South India. The oronized zones of continental outgrowths are characterised by tecto-igneous cycles, which usually end with invasions of mafics, ultramafics or nepheline-syenites.

Some vestiges of the oldest volcanic rocks are localised in the Mysore and Aravalli archaean belts. In Mysore such rocks are followed by keratophyres and spilites, marking a geosynclinal phase of volcanic activity. The younger ill-sorted sediments have an unmistakable stamp of geosynclinal facies. The Aravalli belt may be a portion of a single belt or another continental outgrowth of an independent embryo shield. Of the two succeeding major orogenic cycles, in the Eastern ghats and Satpura belt, the former one, with localisation of granulites and anorthosites, was perhaps associated with a tidal drag. Thus the Indian craton with its different parts of different ages, formed subsequent to nucleation and was certainly not a torn off part of a still larger shield.

6. **The Quartz-reefs of Bundelkhand and their origin.**

R. C. MISRA, Lucknow.

The quartz reefs are a very prominent feature of the Geology of Bundelkhand. They run for long distances in a more or less constant direction, i.e., N.E.—S.W.; seldom showing discordant relation with the surrounding gneisses and granites. The view of older workers that they are the Ultra-acid modification of the granite magma seems to be untenable. No granitic or pegmatitic minerals like feldspar, mica, beryl etc., are present. On the other hand they are mostly made up of massive

ferruginous quartz and white veins of silica which are of a later origin. The presence of masses and veins of pyrophyllite and associated geode like bodies of diasporite in the quartz reefs is a noteworthy feature. The pyrophyllite masses conform with the strike and dip of the reefs.

The reefs are highly sheared, brecciated, crushed and epidotised. The granites and gneisses at their contact with the reefs often show intense shearing and brick-red coloration, a feature common to shear zones.

It may be suggested that the quartz reefs of Bundelkhand are largely recrystallised quartzites. The quartzites may be members of the older metamorphites like the various varieties of schists and amphibolites. Their constant N.E.—S.W. direction might represent the original disposition of the bands of quartzites. The association of quartz reefs with masses of pyrophyllite appears to show the same setting, as in the case of pyrophyllite deposits of North Carolina, where this mineral occurs in highly developed shear zones.

7. The Age of the Earth—A remarkable coincidence between the Modern Scientific and the Ancient Indian views.

S. P. DESHPANDE, Nagpur.

The paper gives an account of the remarkable similarity observed in the figure of the age of the earth as determined by the modern scientific methods on one hand and as calculated from the ancient Indian chronology on the other.

Modern radioactive methods show that the minimum age of the earth is about 2,000 million years.

The ancient Indian chronology, with its cycles of Yugas, Mahayugas, Manwantaras and Mahapralayas, is discussed in some detail. The age of the earth according to this system is also about 2,000 million years since the last Mahapralaya.

In the end, some remarkable similarities between some of the ancient Indian and the modern ideas about history of the earth and the concept of sedimentary cycles have been pointed out.

8. Geology and Structure of parts of Srikakulam District, Andhra Pradesh.

A. SRIRAMADAS and M. M. RAO, Waltair.

Variation in structural trends from N.W.—S.E. through E.—W. to N.E.—S.W. is noticed during the mapping on one inch to a mile scale of about 145 square miles area located in between Latitudes $18^{\circ} 15'$ and $18^{\circ} 22' 30''$ and Longitudes $83^{\circ} 45'$ and $83^{\circ} 0'$ in Srikakulam district. Ten square miles in the south-eastern part of the above area at Mulanga Konda is structurally mapped on four inches to a mile scale.

The geological formations in the area are the Khondalite Series consisting of the garnet, sillimanite gneisses, the garnetiferous quartzites, the quartzites and the calc-granulites; the charnockites consisting of the basic, the intermediate, and the acid types; the porphyritic granite gneisses; the granites; the pegmatites; and the quartz veins. The specimens collected from the above rock types are subjected to advanced optical and chemical studies.

The N-W—S-E structural trends of the area are parallel to the Mahanadi strike, although the area forms part of Eastern Ghats, which have a N.E.—S.W trend. The presence of major plunging folds, drag folds, and silicified zones occupying the planes of weaknesses, show that the area was subjected to extensive tectonic disturbances.

9. Geology of the area around Sihara Tahsil, Jabalpur District, M.P.

UMA SHANKER, Banaras.

The study of the geology of an area covering about 240 square miles of Jabalpur district has revealed quite a number of features of geological interest.

The apparent geological succession in the area is as follows :

Quaternary	... Alluvium.
Tertiary	... Laterites : Deccan Trap—unconformity.
Cretaceous	... Lameta—nodular limestone.
Upper Jurassic	... Gondwana : Conglomeratic sandstone—unconformity.
Purana	... Bijawar Series : Lora group Sihora main beds (shales, Phyl- lites, slaty shales Haematite quartzite with Haematite and manganese ores). Epidiorite. Gosalpur quartzite (gritty mot- tled quartzite manganese at places)
Archaean	... Granite and Gneissose granites.

The granite near Piparsara village running in an E.N.E.—W.S.W. direction is characterised by its Topography, blistered appearance on the weathered surface owing to the phenocrysts of feldspar and exfoliation weathering. In this granite, pegmatite, aplites and quartz veins are observed.

The next series of rocks that overlie these metamorphics are the rocks of Bijawars. Structurally the Bijawar formations is very interesting. The rocks are cross-folded, high dipping synclines known as Lora Synclines; minor anticlinal flexure are also seen near Burahagar in this area.

The Bijawars of this area are divisible into two groups. The Gosalpur quartzite at the bottom and Sihora main bed coming over it. The latter which outcrops east of the Sihora Town is named after it. Other is Gosalpur quartzite named after Gosalpur. These formations are economically very important, with associations of iron and manganese minerals. These minerals occur together as well as independently. The Sihora Main beds consist of shale, ferruginous shales, compact slaty shales, phyllites, Hematite Quartzite associated with iron and manganese.

The nodules of pyrolusite, near Gosalpur, show spongy texture.

The lateritic rocks having been deposited on the Gosalpur quartzites are of recent times. The adjoining Sihora shales which form the long and well defined valley occur west of Gosalpur. The relation of these two beds is very obscure.

Among the younger formations, the most interesting is the Deccan Trap, with which ochres and laterites are associated. They represent the weathering products of the Trap rocks under tropical conditions. In some instances, the laterisation has been produced up to considerable depths. These laterites are source of low-grade iron-ores in this area.

10. Scarps in the Jaisalmer Formation, Jaisalmer District, Western Rajasthan.

J. SWAMI NATH, J. G. KRISHNAMURTHY and G. J. CHANDAK, Calcutta.

The region occupied by the Jaisalmer formation of the Jurassic Period, NW and W of Jaisalmer town in Western Rajasthan, has low relief and consists of cuestas and vales. Lithology and gravity faults have controlled the formation of scarps in this region. Scarps formed due to differential erosion trend roughly NE-SW for over 10 miles, while those controlled by vertical normal gravity faults trend

between NNW-SSE and NNE-SSW give rise to resequent fault line scarps and are traceable over half a mile to 3 miles. The faults are arranged *en echelon* with throws varying from a few feet to 300 feet giving rise to horsts and grabens.

11. Geology and Structure in parts of Almora District, Uttar Pradesh.

M. R. SUBRAMANYAM and R. S. JAIN, Calcutta.

Further Geological mapping in western Almora district, including Plane-Table mapping on large scale, has revealed structures more interesting and complex than realised earlier (see M. R. Subramanyam and R. S. Jain, Proc. Indian Science Congress, 46th Session, 1959), and has brought out features which have some bearing on the prospects of locating economic ore-deposits in the area.

200 feet to 1 inch mapping of the Chhanapani-Shishkhani area (which shows several occurrences of chalcopyrite and galena), about five miles southwest of Bageshwar, shows that the oldest stratigraphic unit in the tectonic window (see reference above) is a slate-shale unit; the dolomite overlies it on thrust sheets; this thrust as well as the dolomite is again overthrust by a quartzitic unit which is thus brought directly over the other units; this latter thrust contact is dominated by chlorite schists, talc schists and highly altered basic rocks (now represented by chlorite schists and epidiorites).

The dolomite alone shows several minor occurrences of galena and chalcopyrite, localised in the dolomite along bedding, joints, slip planes and minor shear or crush-breccia zones. These traces of mineralisation end abruptly against the slate-shale unit or quartzite where these abut the dolomite. It would appear that the mineralisation has not come through the underlying slates and shales but has its source or roots of activity elsewhere in the area, the thrust having brought part of the mineralised dolomite on to the other rocks. Until the source or roots of the mineralisation is located and correlated with the present shows, the primary lodes cannot be followed and evaluated.

The roots of the mineralisation might be under the thrust sheets, or much further north outside the area under study.

12. On the Structure of part of the Singhbhum Shear Zone to the south of Tatanagar, Bihar.

A. K. BANERJI, Calcutta.

The Singhbhum shear zone, to the south of Tatanagar, has been affected by thrust-folding on all scales. The shear zone is about one-and-a-half to two miles wide in the area studied and is bounded by two major thrust planes separating the rocks therein from two groups of rocks to the north and south respectively. Between the two thrust planes the rocks are folded into a major antiform overturned to the S.S.W. and trending E.S.E.—W.N.W., slightly askew to the E.—W. trend of bedding (S_1) in the region. Its axis is sub-horizontal but with gentle culminations and depressions along it. The antiform consists of a series of minor, short and parallel anticlines and synclines similarly overturned to the S.S.W. This folding took place under environments of plastic mobility when a predominant axial plane cleavage (S_2) was superimposed upon bedding (S_1), the trace of which is often preserved on S_2 as a set of prominent lineations lying always on the N.E. quadrant.

With decrease in plasticity the overturned folds were sliced by closely spaced shear planes involving large scale penetrative slip along the limbs of the folds. This heralded a second phase of folding when broad flexures and minor folds developed

parallel to the direction of slip due to extension of the rocks in that direction and therefore compression at right angles to it. Sometimes a sub-vertical axial plane cleavage (S_3) trending N.N.E. developed due to these folds. The trace of S_3 appears as another set of lineations on S_2 lying again on the N.E. quadrant.

Proceeding further in time as the regional compression declined the period of major fold-thrusting drew to a close. The rocks became still less plastic and drag developed in the rock pile due to retardation in movement. Puckers were developed about sub-horizontal axes and transposed along a new set of surfaces (S_4) trending E.S.E.—W.N.W. in response to these movements. This was a third phase of folding in the shear zone rocks. The S_4 surfaces show two sets of lineations, mutually at right angles, due to the intersection of the down-dip and sub-horizontal folds on S_2 with these surfaces.

Thus the shear zone rocks have been folded about three successive axes during a period of continuous deformation in the region.

13. Some aspects of the Stratigraphy around Rakha Mines, Singhbhum District, Bihar.

M. A. ANANDALWAR and M. V. N. MURTHY, Calcutta.

Some aspects of the stratigraphy around Rakha Mines, Singhbhum district, Bihar, is presented in this paper. The stratigraphy has been established below the Barasaitola ($22^{\circ}40' : 86^{\circ}23'$) quartzite up to the first (northern) Rakha quartzite and from the Singhbhum granite up to the meta-volcanic group based on primary sedimentary structures, such as, current bedding with truncated tops, convolute laminations (primary intra-formational deformations), sole markings, ripple marks; and from secondary structures, such as bedding/cleavage relations, drag folds, plunge of minor folds and closures of folds. The thickness of the various formations have been established partly by actual measurements and partly by calculating from the average dip and width. The stratigraphic position of the shear zone rocks and the structurally underlying quartzite is not known. The following stratigraphic table is presented.

<i>North of Shear Zone</i>	<i>Thickness in feet</i>	<i>South of Shear Zone</i>	<i>Thickness in feet</i>
Barsaitola quartzite : massive current bedded quartzite.	} 140	Dhanjori meta-volvanics meta-basalts, inter-bedded tuffaceous phyllite, biotite schist, gabbroic rock and epidiorites	2,500
Alternating beds of arenaceous and pelitic sediments with convolute.			
Predominantly garnetiferous mica schists.	} 4,000	Dhanjori quartzite and tuffaceous phyllite (interbedded)	} 1,500
Rakha quartzite : quartzite, quartz-schists, kyanite- quartz-sericite-schist.		Arkose and arkosic (conglomerate)	
	100 to 150		50 to 100

Shear Zone rock

Quartz-chlorite-biotite schist, feldspathic-biotite schist, quartz chlorite
schist, quartz magnetite rock with quartzite breccia ... 600 feet.

14. Importance of Parseoni Group—a separate gonditic ore bearing formation in the Sausar Sequence.

NITIN KUMAR BASU, Calcutta.

Structural and stratigraphic study of the Mahuli-Ramtek area suggests that the Parseoni Group represents a distinct rock unit below the Kalapatha Group (Fermor's Utekata and Lohangi stages of the Sausar series). As the available evidences indicate, manganese rocks (typical gondite, rhodonite-gondite etc.) which occur in the Parseoni Group are of sedimentary syngenetic origin. Mineragraphic study reveals that manganese ore is at least partly if not wholly secondary being derived from the metamorphic manganese minerals.

An equivalent of the Parseoni Group is met with in the Deolapar area as is suggested from the West's (1936) description where he has put it as the Mansar Stage over the calc-marble sequence though it occurs below the Utekata-Lohangi stages (Kalapatha Group) towards the core of an anticline described by him. Manganese rocks occurring near Khapa in the Gumgaon-Ramdongri chain of deposits may be possible equivalents of the Parseoni Group.

The present study reveals that there are at least two widely spaced gonditic ore bearing horizons: (1) in the Mansar Group equivalent to the Fermor's Mansar Stage and the other (2) in the Parseoni Group below the Kalapatha group (i.e., below Fermor's Utekata and Lohangi stages). As the previous maps were interpreted by earlier workers on the basis of only one gonditic horizon (which was then referred to as the Mansar stage), it is evident that earlier maps need re-interpretation in the light of new findings.

15. Effect of Chemical composition on Elastic Wave Velocities in Makrana Limestones.

S. BALAKRISHNA, Hyderabad.

Elastic wave velocities, both longitudinal (V_L), and torsional (V_T) in km/sec. have been measured in a number of limestones chosen from Makrana; employing the pulse technique described by Krishnamurthi and Balakrishna (1953) involving the phenomenon of total internal reflection. It has been observed that velocities are high in metamorphosed limestones in contrast to other limestones. Limestones have been chemically analysed. It has been found that as CaCO_3 content decreases the velocity values both V_L and V_T decrease considerably. In one limestone where the CaCO_3 is 96.15% the velocity values are ($V_L=6.9$, $V_T=2.6$); while in other the CaCO_3 is 65.48% the velocity values are ($V_L=6.4$, $V_T=2.3$).

16. Note on the Structural Studies of an Archaean Tract near the Trijunction of Bankura, Midnapore and Purulia Districts, West Bengal.

P. S. CHAKRAVARTY, Calcutta.

The structural geometry of metamorphic rocks in an Archaean Tract ($22^{\circ}54'$ — $22^{\circ}57'$ N; $86^{\circ}36'$ — $86^{\circ}50'$ E) near the trijunction of Bankura, Midnapore and Purulia Districts is investigated by statistical analysis of the preferred orientation of structural elements such as foliation, lineation and fold axes. The investigation reveals the presence of large double plunging folds in the area. The axes of the folds trend east-west with a swinging to WNW and ENE due cross folding. The intensity of arching due cross folding increases from north to south,

With reference to regional structure the oval outcrop of the Kuilapal granite-gneiss occupies the core of a plunging anticline overturned towards south-west in the western part of the cross-fold system between the axes of culmination and depression.

The Chhendapathar granite and the tungsten deposits are located along the axis of culmination of the fold system which broadly coincides with axial zone of the cross-folds.

17. A new method of analysis of Deformed Pebbles.

DEVENDRANATH KANUNGO, Dhanbad.

A structural analysis has been made of the deformed pebbles found in the basal conglomerates of the Torridonian and Moinean rocks of the Lochalsh Peninsula which lies across a section of the Moine Thrust Zone of the North-West Highlands of Scotland. Dimensional analysis of these deformed pebbles has been made as suggested by earlier workers—Cloos (1947), and Oftedal (1948). But these methods were not found suitable for plotting the deformation along the three principal axes of the pebble on a single diagram which would show the three variables at a glance. A new procedure has therefore been adopted to represent the amounts of deformation, along the three axes of the ellipsoidal pebble, on a triangular diagram. These triangular diagrams along with stereographic projections of the elongation of the pebbles and petrofabric diagrams throw much light on the mechanics of rock deformation and can be integrated to give a consistent movement pattern within the major structural units.

18. Structures of some crushed Kaladgi Rocks.

Miss KAMAL GHASIAS, Poona.

An outlier of Kaladgi rocks occurs in the Paragad hills ($15^{\circ}45' : 75^{\circ}8'$) in Belgaum District. As was noted by Foote, the rocks of the outlier, quartzites and a few conglomerates, are faulted against Archaean rocks along their northern boundary which may be traced for nearly seven miles. Over most of the outlier, beds dip at low angles, rarely exceeding 8° , but those near the fault plane, suddenly attain high dips, generally 70° to 90° , and their rocks have been deformed. At the base of the series occurs a thin conglomerate bed containing oriented pebbles and showing a distinct lineation parallel to the bedding planes. Adjacent quartzites exhibit an excellent form orientation when examined microscopically, though no signs of it are to be seen in hand specimens. The form orientation seen in slices of the quartzites, is like that seen in corresponding sections of the conglomerate.

Measurements of the optic axes of quartz grains in oriented slices cut along three mutually perpendicular directions, showed that the rocks are true tectonites. Orientation contour diagrams representing the a c and b c planes, reveal a strong preferred orientation and the maxima are distributed to form girdles which lie in the a b plane and have c as their axis. The a b diagrams, parallel to the foliation and bedding planes, show a much weaker orientation, and the maxima are distributed irregularly to form a girdle around c .

The preferred orientation appears to have been impressed on the rocks by compressive forces which acted on the rocks subsequent to their normal faulting and which also were the cause of their high local dips.

19. Studies on deformation characteristics of Conglomerates along Shear Zone between Gandamara and Toira, Singhbhum District.

BANKIM MUKHERJEE and KALYAN ROY, Jadavpur.

Deformed conglomerate exposures occur along the shear zone between Gandamara and Toira, Singhbhum District (Lat. $22^{\circ} 35'$ to $22^{\circ} 43'N$ and Long. $85^{\circ} 30'$ to $85^{\circ} 45'E$). The pebbles are triaxial ellipsoid in shape with longest and intermediate axes on axial plane schistosity and longest axes lineated down-dip. Folds are of tight isoclinal type. Pebbles are quartzitic, phyllitic, epidioritic and granitic in matrices of arkose, phyllite, phyllonite, slate and epidiorite etc.

Major regional set of folds are slip-folds in essential superposed by cross-folding. The geometrical complexities have developed due to gradual vectorial change of this later folding.

Pebbles in average have radii between 2 and 4.5, with deformation in per cent of "r" for a-axis 200-350, for c-axis 220-575 and b-axis extension or reduction in per cent of "r" between -10 and 90.

Elongation in a-axis and flattening in c-axis are due to intense thrust movement, which to some extent have been modified by later cross-folding. Extension in b-axis prior to cross-folding may be due to, rather speculative, post-formational deformation (syneclastic) by transposing b-lineation of early tectonic period to a-lineation, or by para-formational (epiclastic) deformation due to thrusting and cross-puckers.

20. The Stratigraphic position of Pakhals.

S. BALAKRISHNA and Y. JANARDAN RAO, Hyderabad.

The stratigraphic position of Pakhals has been a controversial problem for more than a decade. Around the Yellandlapad region the Pakhals are represented by phyllites and schists, quartzites and marbles and separated by three 'granite' bays. Presuming that granites are of Archaen age and show intrusive relationship with Pakhals, Mahadevan regarded them to be Dharwars. From their occurrence and lithological characters Heron considered them to be of Cuddapah age only and the intrusive effects shown by the Archaen granites is supposed to be due to a later melting as consequence of deep folding. It is the contention of the authors, that to come to any conclusion regarding the age of Pakhals on the basis of supposed Archaen age of granites is not correct since there are granites as late as Tertiary. Further, in detailed field investigation of nearly 300 square miles it has been observed that there is very little true granite in all the three bays. On the other hand they are all regionally metamorphosed complexes represented by granulites in the Western bay, gneisses, schists, amphibolites etc. in the central and eastern bays. Thus it is evident that the stratigraphic position of Pakhals has to be determined by other detailed investigations and not by granitic intrusions.

21. Preliminary observations on Geology of the Macherla (Guntur-A.P.) Area.

S. BALAKRISHNA and R. SEKHAR REDDY, Hyderabad.

The stratigraphic position and the thickness of the Palnad Series is one of the controversial and interesting problems of Purana geology. Until now very little laboratory work has been done on these rock types. In this paper an attempt has been made to present certain field features observed in Macherla area (Guntur District—A.P.) as a prelude to the laboratory work. In this area the limestones,

shales and quartzites of Palnad Series occur in association with undoubted quartzites of Kistna Series of upper Cuddapahs. The quartzites of Kistna Series are mostly massive, but at places show bedding with dips varying between 15° to 20° , in contrast with the rock types of Palnads which are mostly horizontal. The occurrence of inliers of Archaeans and Cuddapahs indicate that the limestones are thin. A conglomerate bed not reported so far has been traced, and a succession similar to Kurnool Series can be established. Detailed laboratory investigations, with special reference to physical properties are under progress.

22. Palaeogeography of the Athgarh Age.

P. G. ADYALKAR, Calcutta.

A careful examination of the Mahanadi Valley with reference to the flora and the intrusives of the Athgarh sandstones and the glacial action during the Talchirs has revealed a valuable information on the palaeogeography of the Athgarh age in Athgarh area. It is suggested that a great lake, more than 200 sq. miles in area, occupied an extensive country west of Cuttack before the dawn of Liassic age. The sedimentation in the Athgarh basin continued throughout the Liassic and probably extended even after that. On the silted platform of Athgarh basin drained a great river with its relict in the form of a meander, concave towards the present Mahanadi river. Subsequently the river changed its course.

23. Geology of Part of Kalahandi and Bolangir Patna Districts of Orissa.

C. RAY, Calcutta.

The paper embodies the results of geological examination of a strip of country generally occurring on the east side of the Raipur—Vijaynagaram section of the S. E. Rly. approximately six miles in width intercepted between Titilagarh ($20^{\circ} 17' 30''$: $83^{\circ} 9' 00''$) in the north to Lanjigarh Road ($19^{\circ} 57' 36''$: $83^{\circ} 24' 12''$) in the south. The following points have emerged as a result of this study : (1) Two different units viz. (i) pelitics represented by schistose biotite-gneiss, hornblende-gneiss and amphibolite, and sillimanite-garnet-gneiss, including khondalite in succession and (ii) dominantly igneous suite represented by porphyritic and augen-gneiss younger than (i). (2) The pelitics occupy synclinal areas with variable pitch, general direction being N.E. The adjacent porphyritic and 'augen' gneiss occupy anticlines. (3) The general strike direction for all the rock-types is N-N.E.—S-S.W. with a high dip (more than 60°) towards E-S-E. But there are instances in khondalite and hornblende-gneiss where strike is N-W—S-E. probably carrying the impression of relict Mahanadi strike before the superimposition of dominant Eastern Ghats strike. (4) A striking similarity exists between this part of Orissa and Ceylon so far as archaean geology is concerned in respect of lithology, general disposition of strike and chronology. It also bears a remote but significant resemblance in these respects with Nagpur—Chindwara region.

Minerology

24. Rhodochrome—a chrome-penninite (chlorite) from the Byrapur Chromite deposit, Mysore.

S. VARADARAJAN, Bangalore.

A detailed study of chrome-chlorites from the chromite deposit of Byrapur ($13^{\circ} 07'$, $76^{\circ} 25'$) Hassan District, Mysore State, revealed the occurrence of a new

variety of chrome-penninite—Rhodochrome, in addition to kammererite, a chrome-penninite and kotschubeite, a chrome clino-chlore described earlier (1957) by the author.

The physical properties, optical characters and chemical composition of the mineral are determined. The mineral is scaly in habit. In its chemical nature it is similar to kammererite in that it falls in the Penninite field in Hey's diagram. But the mineral is distinct from kammererite in its optical characters. It has a higher and more variable $2V$ (40° – 90°) and lower refractive index ($N_z : 1.572$ – $N_z : 1.566$) than kammererite. Its optic sign is either (+) or (–) irrespective of Cr_2O_3 per cent.

Dana has described a variety of chrome-chlorite which is similar in physical and chemical characters to the variety under study as Rhodochrome; but puts it as a variety of kammererite in the absence of any optical data. The author prefers to retain the term Rhodochrome for the mineral from Byrapur but considers it as a variety of chrome-penninite different from kammererite. So there are two varieties of chrome-penninites—kammererite and Rhodochrome. The only variety of chrome-penninite from Byrapur is Rhodochrome.

25. On the occurrence of Stilpnomelane around Seraikela, District Singhbhum, Bihar.

P. P. AGRAWAL, Patna.

The author records, for the first time, the occurrence of Stilpnomelane, in the modified quartz-diorites of Seraikela ($22^\circ 42' : 85^\circ 56'$). The modal analysis of thin sections reveals that the quartz-diorites contain 6.68% to 8.06% of Stilpnomelane. Stilpnomelane occurs in fine to coarse plates in sub-parallel to criss-cross groups or in semiradial sheaf-like groups of curving plates. It is also observed replacing the chlorites. The most common associated minerals are quartz, albite, epidote, hornblende, chlorite, sphene, and apatite.

The Stilpnomelane is highly pleochroic from lemon yellow to dark reddish brown and the scheme of pleochroism is $X < Y$ and Z . The maximum index of refraction is $1.682 \pm .002$.

Stilpnomelane is formed by low-grade regional metamorphism (Saussurite facies) of quartzo-feldspathic sediments containing a high ratio of Fe and Mg. The presence of chess-board albite in the quartz-diorites reveals soda-metasomatism of the pre-existing chlorite-schists and Stilpnomelane is accounted as a reconstituted product of chlorite, crystallised at post-movement phase.

26. Preliminary Zircon studies on Granitised Biotite-Gneisses forming part of the Chota-Nagpur Gneissic Complex in Purulia District, West Bengal

T. M. MAHADEVAN, Calcutta.

The paper presents the results of preliminary studies on zircons in certain granitised and felspathised gneisses which constitute the bulk of the Chota-Nagpur gneissic complex in about 300 sq. miles of the area in Purulia district, W. Bengal, falling between lat. $23^\circ 00'$ and $23^\circ 15'$ and long. $86^\circ 15'$ and $86^\circ 35'$.

Zircons in the following three rock types, which represent the different stages in the metasomatic evolution of the biotite-gneisses, have been studied. 1. Biotite-schist, forming an enclave in the biotite-gneisses. 2. the relatively more granitic portion of the gneisses and 3. the intensely felspathised portion of the gneisses.

The rock types (1) and (2) have a majority of zircons which have complete colourless to pale brown overgrowths. The nucleus in the zircons in (1) are well rounded and have sharp boundaries. In the zircons in (2) the boundaries of the nucleus tend to become more diffuse. While only a few of the mantled zircons in (1) have euhedral outlines, over 15% of the zircons in (2) are euhedral. In addition to mantled zircons, rock types (1) and (2) also contain a small percentage of euhedral crystals of colourless zircons.

In rock type (3), the colourless euhedral crystals of zircon predominate. These show typical growth zones and occur as long slender crystals with a characteristic length/breadth ratio. A large number of these crystals have grown into parallel aggregates. A small percentage of the zircons in rock type (3) is mantled and these are similar to those met with in types (1) and (2).

It is inferred that the colourless overgrowths in the mantled zircons have developed from solutions which in the felspathised gneisses form euhedral crystals. The source of zirconium solutions is uncertain, they might have been derived from external sources or by solution of detrital zircons and recrystallisation during granitisation. Further work is in progress. The paper emphasises the importance of zircon studies in elucidating the evolution of metasomatic rocks.

27. Study on the geochemical association of niobium in some minerals.

B. DAS SARMA and A. N. CHOWDHURY, Calcutta.

The data on the geochemical association of niobium in minerals in India is meagre. This problem has importance from both economic and scientific point of view. Concentration of niobium in materials like bauxite may be of economic significance. From geochemical aspect niobium may serve as a tracer for explaining the genesis of ore deposits.

Ten samples of various types, bauxite, ilmenite, rutile, lithomarge, vanadiferous magnetite, red mud after alumina extraction, from different parts of India were analysed spectrographically.

Niobium content varied from 50 p.p.m. to 400 p.p.m. The association of niobium with titanium minerals was observed.

28. Cummingtonite from Hosalli, Munirabad Area, Raichur District (Mysore State).

I. S. VENUGOPAL, C. NAGANNA and M. S. SADASHIVAIAH, Dharwar.

An amphibole from the granulite found associated with iron ore formation of Munirabad has been chemically analysed and a detailed optical study has been made. The calculated Warren's formula, optical observations and the chemical study indicate that the mineral under investigation is a manganese-poor hydroxy-cummingtonite with 52.14% FeSiO_3 , 0.66% MnSiO_3 and 47.20% MgSiO_3 having almost the same origin as the other reported cummingtonites from the iron-ore formations of Mysore State.

29. Study of the Plagioclase Felspars of the Granites, Gneisses and Associated Rocks of Hungund Ilkal, Bijapur-Raichur Districts (Mysore State).

J. D. CRUZ, C. NAGANNA and M. S. SADASHIVAIAH, Dharwar.

This paper deals with the nature of the plagioclase felspars of granites, gneisses and associated rocks around Hungund and Ilkal. A table and a cumulative diagram

are given to show the anorthite content and various twin laws. Two other cumulative diagrams, one showing the transferred poles of the complex laws and the other to indicate the high or the low temperature optics of the feldspars are given. From Tertsch's stereogram the feldspars of the granites, gneisses and associated rocks of the area are inferred to belong to the low temperature series. Among the twin laws studied in the plagioclases, Albite-Ala-(76) and Albite laws (61) are of the largest incidence, Manebach-Ala-Acline (26) is the next most predominant law. Pericline (9), Carlsbad (4), Manebach (9) are the less observed twins. Two grains are twinned on the Albite-Carlsbad law. Untwinned grains of plagioclases are more abundant than the twinned grains. Proportions of untwinned (U), A-twins (A) and C-twins (C) are plotted on Gorai's UAC diagram. The plotted points indicate a metamorphic origin to the rocks of the area.

30. Quartz Paramorphs after Tridymite or Cristobalite from a Rhyolite associated with the Pillow Lavas near Maradihalli, Chitaldrug Dist., Mysore.

M. R. SRINIVASA RAO and C. GUNDU RAO, Bangalore.

The quartz phenocrysts in a rhyolite associated with the pillow lavas of Maradihalli, Chitaldrug Dist., Mysore, from petrographic data have been identified to be paramorphs after the high temperature form Tridymite or Cristobalite. Although these have been described from several localities both in India and abroad, as far as the knowledge of the present authors go, it is for the first time they have been reported from Mysore. As it is well known that the inversion temperature of quartz from its high temperature modification, Tridymite or cristobalite is at about 870°C, it may be surmised that the pillow lavas associated with these rhyolites may have as well been extruded at about this temperature.

31. Zircons from some Rhyolites.

C. GUNDU RAO, Bangalore.

Current petrological literature reveals broad generalisation about the use of elongation ratio (l/b) of zircons in genetic studies of granites. It has been stated (Poldervaart and Backström, 1950, and Poldervaart, 1950) that magmatic granites show zircons with an elongation index of 2.0 or more and granitised sediments a value less than 2.0. In this connection, it was realised that it would be interesting to study the elongation ratio of zircons in rhyolites whose magmatic origin is almost undoubted. Four samples of Rhyolites (F_2 -10, 49-25, 49-105, and F_4 -48) were loaned to the writer by Dr. O. F. Tuttle of the Pennsylvania State University to be analysed for zircons. Of these samples, one (F_2 -10) gave an elongation peak of 1.3; samples 49-25 and 49-105, at 1.7 and F_4 -48 three peaks, one prominent at 1.9, the lesser at 2.3 and the last at 2.9. A re-examination of the concentrates in the light of these findings revealed that the low elongation index in the first three samples was mostly due to the fact that the grains were euhedral and mostly equant. Therefore, elongation ratio may not always be a reflection of the rounded nature of the zircons. It may be suggested that use of elongation ratios of zircons in genetic studies of granites may not always lead to reliable conclusions.

32. On Garnet Coronites from Koraput, Orissa.

MIHIR KUMAR BOSE, Calcutta.

Garnet coronas are common in meta-mafites, particularly along the marginal parts of a small plutonic body within garnetiferous quartz-sillimanite gneiss (khonda-

lite). The coronites are not spatially related to quartzo-felspathic invasives associated with the body. The garnet coronas are observed at the contact between mafic minerals and plagioclase (An_{42}), being usually more idioblastic towards plagioclase. The reaction rims with garnet forming the outer shell are 'Iron-ores—biotite—(felspar) garnet; biotite—garnet; Iron-ores—garnet; Iron-ores—brown hornblende—garnet.

The associated plagioclase shows intense clouding, caused by minute inclusions of opaque and nonopaque rods, aligned dominantly in (010) and less frequently in (001). X-ray powder photograph reveals the opaque inclusions in felspar to be chiefly hematite. Typically the coarser plagioclase grains are twinned on combined Carlsbad-albite law, the smaller interstitial individuals are either twinned on acline laws or are untwinned. The U A C ratios in the coronites plot more towards the reconstituted rocks. The ore minerals revealed in reflected light include magnetite, hematite, and infrequent pyrite. Hematite appears to be secondary after magnetite.

Coronation appears to be later than clouding in plagioclase. The garnet coronites show gradation to rocks with disseminated garnet. The formation of garnet corona is considered a metamorphic phenomenon, in a limited water concentration.

33. Uraninite and Secondary Uranium Minerals from Bisundni and Gaya, India.

BIBHUTI MUKHERJEE, Calcutta.

An X-ray study has been made on Bisundni uraninite and Gaya uraninite, and on the secondary uranium minerals formed in coloured zones as alteration products of uraninite. The cell size of Bisundni uraninite with the age 735 million years has been determined as $5.441 \pm 0.003 \text{ \AA}$ and after thorium correction as 5.439 \AA . The cell size of Gaya uraninite with the age 900 million years has been determined as $5.460 \pm 0.003 \text{ \AA}$ which comes out at 5.442 \AA after thorium correction. Wasserstein's classification of α -type Bisundni uraninite and γ -type Gaya uraninite for the correlation of age is not, however, justified. Age determination based on the variation of cell size with the content of radiogenic lead has been found to be quite untenable with observed evidence due to the varying state of oxidation of U^{+4} to U^{+6} in natural uraninite and other factors influenced by the presence of certain elements in solid solution.

The secondary uranium minerals identified in the coloured zones of Bisundni uraninite are fourmarierite (orangered), kasolite (orange-yellow), clarkeite (chocolate-brown) and beta-uranophane (canary-yellow and dull yellow). Vandendriesscheite, fourmarierite (dull red), kasolite (brownish-yellow), clarkeite (dull brown), beta-uranophane (yellow) and meta-autunite (greenish-yellow) have been identified in the coloured zones of Gaya uraninite.

34. Minerals of Northeastern Brazil. IV. Rutile Crystals from Itacuruba, Pernambuco.

A. BHASKARA RAO, Recife, Brazil.

Following are the interesting observations made on crystals of rutile from Itacuruba, of Pernambuco state.

Prismatic crystals of rutile with a metallic luster, showing perfect cleavages and a deep brownish red colour, give a yellow streak. Along the periphery, as zoning with the crystals, is fine to medium granular deep reddish black nigrine (?) giving a black streak. Along the cleavages are noted platy intergrowths of the same dark

mineral, resembling ilmenite, but with black streak. Both the zoning and intergrown minerals have a lower hardness than rutile.

It is suggestive of a possible "growth zoning" due to substitution of titanium by iron, with a mixed crystal or solid solution relation between rutile and nigrine.

35. Scheelite—Powellite Variation.

A. BHASKARA RAO, Recife, Brazil.

Characteristic paragenesis of scheelite from NE Brazil includes calc-silicates such as epidote, vesuvianite and grossularite, together with sulphides, molybdenite, chalcopyrite, and pyrite. During the extraction of tungsten ore from the gangue, always molybdenite is recovered.

Fluorescent colours of scheelite ore are light blue to yellow, and white. Blue is characteristic of scheelite, while the others are due to the presence of molybdenum in scheelite, thus giving rise to powellite.

Powellite is seen to be grading white to yellow in different proportions. It is thus possible that there exists a variation between scheelite and powellite, probably giving rise to other varieties in between.

Also it might be noted that oxidation of molybdenite and the consequent substitution has resulted in the formation of powellite. In addition, metasomatic diffusion operating in small distances might, as well, have given origin to the probable scheelite-powellite variation, as the scheelite mineral deposit here has been considered as the resultant of contact metasomatism.

36. Minerals of Northeastern Brazil. III. Pinguite.

A. BHASKARA RAO, Recife, Brazil.

This paper presents some observations on Pinguite, collected from Borborema pegmatite region of the Northeast of Brazil.

A hydrated silicate of ferric iron, it is a rare sample with greasy green colour, and soapy feel. Massive in habit, it has a very low hardness, and is easily scratched by finger nail. The specific gravity is about 1.78, and is varying due to the presence of limonitic patches.

Dana considers it as a variety of chloropal, while Hey records it as 'really a member of the chlorite family' though he concedes '. . . But some pinguite is chloropal'. From the X-ray photograph, the d -values of the intense lines are as follows: 15.3; 4.54; 1.515. As the chlorites are characteristic of the 14 KX basal spacing, this pinguite is not included in the chlorite family.

A comparison is made with notronite, another variety of chloropal, and great similarity is observed in the interplanar spacings: 15.4; 4.56; 1.518. Thus this sample is considered as the variety of chloropal.

The dehydration values are also found similar with Nontronite where the greater percentage of water is eliminated before 600°.

37. Minerals of Northeastern Brazil. VI. Fluorescent Minerals.

A. BHASKARA RAO and JUDSON DA CUNHA E SILVA, Recife, Brazil.

Several minerals of the Northeastern Brazil show fluorescence. A study of them under short wave U-V. Lamp. (2537 AU) enable a preliminary classification of the

radioactive species, along with the tungstates. Others such as apatite, zircon, fluorite, and calcite also show their colours differently.

- Phosphouranylite : dull orange
- Autunite and } Bright yellowish green
- Meta-Autunite }
- Gummite : Dull orange
- (?) Uranospinite and Uranocircite : bright greenish yellow
- (?) Johannite : Brilliant green
- Monazite : bright orange
- Zircon : Orange (on the surfaces)
- The *tungstates* are :
- Scheelite : bright gentle blue
- Powellite : white to yellow
- Others are
- Calcite : Brick red
- Apatite : greenish tints
- Fluorite : dull whitish violet.

The rare earth element such as Y in calcite; Tb in Zircon; Ce metals in apatite, are considered to cause this phenomenon. The tungstates show variation in this property due to the substitution of W by Mo. The other rare minerals have not yet been otherwise identified.

38. Micro-indentation hardness of some ore minerals.

SRIPADRAO KILPADY, Nagpur.

The precise determination of the hardness of ore minerals can be extremely useful in their identification. The Murdoch and the Talmage hardness scales, hitherto used by mineragraphers have not been found to be entirely satisfactory. The micro-indentation hardness testing which is widely used by metallurgists, has been now and then applied to the evaluation of the hardness of minerals in the past, but not very successfully. The introduction of excellent miniload hardness testers in recent years, has now placed in the hands of the mineragrapher, a tool whose usefulness cannot be doubted. The Vickers hardness determined on polished specimens of certain manganese and other ores has proved to be quite dependable. The range of accuracy is plus or minus 3 to 4 per cent. The Vickers values for certain ore minerals have been reported.

39. Differential Thermal analysis of Coal from Bukbuka Seam near Khalari, North Karanpura Coalfield, Ranchi District.

BANKIM MUKHERJEE and AJAY BASU, Jadavpur.

Differential Thermal Analysis of the coal from Bukbuka seam, North Karanpura Coalfields, near Khalari (23° 39' : 85° 0'), Ranchi District, was carried out under carefully controlled conditions, to study the thermal criteria characteristic of the coal.

The thermal curves obtained give (i) an endothermic peak at 120°C, which occurs due to dehydration of the coal; (ii) a low temperature exothermic peak at 200°C which lies between dehydration and start of devolatilisation. The cause of this reaction is not very apparent but may be attributed to the oxidation of the coal; (iii) two endothermic peaks at about 520°C and a little over 600°C, these being the primary and secondary volatile loss peak temperatures respectively. The presence of these two volatilisation peaks is indicative of the plasticity of the coal.

The above peak temperatures reveal the coal to be of medium to high volatile bituminous type. The characteristic 400°C exothermic peak is absent, which may be due to dissimilarity in the caking and plastic character of the coal.

On proximate analysis the Bukbuka coal gives : Moisture—6.45%, V.M.—35.92%, Ash—18.54%, F.C.—39.09% and the coal is non-caking and slightly swelling, which go to corroborate the findings by D.T.A.

40. Ore-microscopic Study of the Manganese Ore-minerals of Gowari Warhona, Chhindwara District, M.P.

S. P. DESHPANDE, Nagpur.

The paper gives a detailed account of the ore-microscopic study of the manganese ore-minerals collected from Gowari Warhona, Chhindwara district, M.P. The ore-minerals identified in polished sections are Braunnite, Sitaparite, Hollandite and Psilomelane. In addition, an unidentified mineral is described. The problem of its nomenclature has been fully discussed and it has been tentatively identified as Alpha-vredenburgite.

The typical ore of this area shows a crystalloblastic banded texture. Bands of Hollandite on one hand, and those consisting of Braunnite, Sitaparite, and the unidentified mineral on the other, alternate. Unusual textural features, like the veining of Hollandite and a gangue mineral by Sitaparite, Braunnite and the unidentified mineral, have been described along with the more common textures like the Braunnite-Sitaparite lamellar intergrowth. The mineral paragenesis, based on the textural features, has been drawn up as follows : Hollandite, Braunnite (in part), Sitaparite. The unidentified mineral, Braunnite (in part), Psilomelane.

41. Depthwise variations of Silica, Alumina and Iron Oxides in Fireclay Deposits.

AMITAVA DUTT, Giridih.

Fireclay deposit in Belpahar (Dt. Sambalpur) shows preferential leachings of SiO_2 , Al_2O_3 and Fe_2O_3 resulting in enrichment zones of Fe_2O_3 on top followed depthwise by alumina underlain by silica rich zone. Iron Oxide shows a maximum concentration of 14% within usually 14' from the surface but falls to 1 to 2% at about 25'—the level of underground water. In alumina zone where clay is non-plastic, alumina varies from 36 to 38% and silica from 42 to 48%. In silica rich zone clay is plastic and alumina falls to 24% but silica rises to 56%. The intermediate position between alumina and silica rich zones reports alumina from 29 to 32% and silica from 49 to 52%. The composition of clay becomes constant below the underground water and clay becomes non-plastic.

The data calculated on thermodynamic basis by the author suggest a ten to fifteen times higher solubility of silica than alumina and ferric oxide at Ph of 7.2. This accounts for the selective leaching in Belpahar where seasonal fluctuation of Ph is from 7 (winter) to 8 (summer) and solubility of silica is 2 gr/gall at Ph 7 but 0.62 at Ph 8 with alumina constant at 0.14 gr/gall.

Evidences suggest the formation of clay from shale associated.

42. Differential Thermal analysis curves of prepared mixtures of Clay Minerals obtained with a portable D.T.A. Unit.

A. G. BHUSARI, Nagpur.

This paper presents the Differential Thermal Analysis Curves for the prepared mixtures of the following standard clay-minerals : Kaolinite, Dickite, Pyrophyllite,

Montmorillonite, Hectroite and Halloysite. The curves were obtained with a portable differential thermal analysis unit and are quite reproducible. A brief discussion of the curves obtained and their usefulness in the rough quantitative estimation of the common ingradient of clays is outlined.

PETROLOGY

43. A Note on the Petrology and Origin of Ultramafites of Nausahi, Keonjhar, Orissa.

O. P. VARMA, Dhanbad.

The ultramafites occur in a continuous belt trending roughly N-S for about 2 miles, with a maximum width of a little less than half a mile SE of Hill "1343". From about a quarter of a mile west of Sankona village their outcrop extends northwards across the low-lying regions and then, rising gradually along the southern flanks of the Hill "1343", abuts against green quartzites on the north-northeastern spurs of the hill east of Phuljhora Huli.

These rocks present a striking example of magmatic differentiation of a slowly cooling ultramafic magma resulting in the development of a great variety of ultramafic rocks. Some of the rocks are almost monomineralic, being composed either of olivine or orthopyroxenes with only trivial amount of accessory chromite; others consist of various combinations of these minerals with clinopyroxenes, while rocks composed of ferromagnesian minerals with subordinate plagioclase are also widely represented. The ultramafites have suffered extensive mineralogical transformation and hydrothermal alterations.

In the field the ultramafites form an independent and conspicuous geological unit containing different groups of rock-types which occur as separate masses or dykes within the belt; transgressive relationship of the dyke-like masses of enstatite-bronzite rock towards the adjacent kindred types is a noteworthy field-feature. Specimens displaying sharp contacts between the completely serpentized rocks have been observed. These evidences together with several other observations cited in the paper suggest that the rocks confined within the limits of the ultramafic belt are derivatives of a single originally homogeneous magma of ultramafic composition which differentiated at depth, the fractions being subsequently forced upwards into their present position.

44. On the Epidotisation of the Felspars of the Anorthosites from Barabar, Gaya District, Bihar.

R. N. PROSAD, Patna.

The phenomenon of epidotisation has been studied in the Anorthosites from Barabar (lat. $25^{\circ} 1'$; long. $85^{\circ} 3'$) in Gaya Dt., Bihar. The assemblage of rocks in the Barabar hills comprise of a coarse grained granite, gabbro and a deposit of Iron ore.

In an earlier communication the author has already discussed their petrography (1959).

When fresh the rock is predominantly composed of plagioclase with some hornblende, biotite, sphene, apatite and little or no epidote. Incipient crystallization of epidote has been initiated at certain places by the hydrothermal solutions and other volatiles in the fractures or cleavages produced due to cataclasis. Later on much epidote has formed at the expense of plagioclase. In agreement with Harpum (1954)

epidotisation is thought to be concomitant with the chloritization of the hornblende. Lately the feldspars have been shattered and largely saussuritized and the rock consists of zoisite, clinozoisite, epidote with some grains of scapolite and chloritized hornblende.

The reworking of the Anorthosites by metamorphic agents has been reported from Adirondacks region and Bankura Dt. West Bengal. The mineral assemblage of Barabar agrees favourably with the Bankura Anorthosites but differs slightly from those of Adirondack.

From the evidences it seems very likely that the metamorphic influences are of a later age than the formation of the Anorthosites.

45. Agmatites of Muri-Silli-Jhalida, Ranchi and Purulia Districts.

DILIP KUMAR SEN GUPTA, Kharagpur.

Agmatites of Muri-Silli-Jhalida, Ranchi and Purulia Districts, have been developed from both ortho- and para- amphibolites and hornblende schists. The fragments of agmatites are irregular and of various shapes and sizes.

The foliation or schistosity (S_2) of the different fragments is parallel to each other which in turn is parallel to the S_2 -plane of the surrounding gneisses. They show regular gradation from practically unaltered basic rock to more or less granitic looking migmatite with ghost-like relics and basic clots. Both ortho- and para-amphibolites and hornblende schists have been traversed by replacement veinlets of surrounding granitic rock. Towards the contact with the gneiss, they show concentration of mafic minerals chiefly of biotite.

The relation of potash feldspar to plagioclase and biotite, and of hornblende to clino-pyroxene, sutured contact of quartz against plagioclase, development of myrmekite at the border of potash feldspar, the poikiloblastic textures resulting from the incorporation of earlier formed biotite within microcline porphyroblasts, are some of the evidences suggestive of replacement.

Thus agmatites of the area are formed due to *in situ* granitization of pre-existing ortho- and para- amphibolites and hornblende schists.

46. On the Granitic Rocks Around Hatia, Ranchi District, Bihar.

P. P. AGRAWAL, Patna.

In course of sub-surface exploration during foundation testing of the site for location of the Heavy Machine Building Plant and Foundry Forge Plant at Hatia (Lat. $23^{\circ} 17' N$; Long. $85^{\circ} 18' E$), District Ranchi, about 160 drill holes were made. The representative samples of the drill holes throw sufficient light on the orogenesis and granitization of the terrain.

Orogenesis and granitization have given rise to migmatites, banded-gneisses and granites. The extreme heterogeneity in composition of the granite-gneisses and migmatites, the presence of lenses of quartzites, the widespread development of metacrysts in the pelitic enclaves and their gradual conversion to granite-looking rocks, with still preserved 'ghost' relics, the highly isoclinal pygmatically folded nature of different rock varieties and development of porphyroblasts as augens in the gneisses, all indicate a syntectonic granitization of the pre-existing sediments. K-Al metasomatism at a late-kinematic stage is also accounted for the microcline metacrysts (porphyroblasts?) and myrmekites of the porphyritic (porphyroblastic?) biotite-granite-gneisses of the terrain.

47. Significance of Metamorphosed Basic Igneous Rocks in the Rakha Mines area, Singhbhum District, Bihar.

M. V. N. MURTHY, Calcutta.

Intense clouding of the plagioclase feldspars in a metadolerite core from Rakha Mines, and also in the Baraghattola picrite (Dunn and Dey, 1942, p. 361) which also shows clouding of the olivine and two-ply coronas, are interpreted as indicating metamorphism of the basic igneous rocks under water-deficient conditions at elevated temperatures. The metamorphism resulted in the garnet-, staurolite-, and sillimanite-bearing mica schists of the region. Development of chlorite from biotite and garnet, was later by wet metamorphism which also converted the basic igneous rocks into amphibolites and hornblende schists (showing chlorite, actinolite and zoisite; green schist or epidote-amphibolite facies). Detailed studies of the country rocks and intrusive rocks in this structurally complex region will enable understanding the complex metamorphic history.

48. Rutile and Ilmenite-Bearing Pegmatite Veins near Gaurangdih, Purulia District, West Bengal.

T. M. MAHADEVAN, Calcutta.

The paper describes the occurrences of rutile and ilmenite met with in a number of localities within about 6 miles radius of Gaurangdih R. S. (lat. $23^{\circ} 26'$: Long. $86^{\circ} 46'$), Purulia District, West Bengal. The mineral occurs in pegmatites and quartz veins that traverse the biotite-plagioclase (andesine)—gneiss and the associated hypersthene meta-gabbros and less frequently the sillimanite-mica-schists of the area. Small amounts of ilmenite are also met with in some of the veins. The rocks of the area have been metamorphosed under conditions of the granulite facies and the presence of rutile-bearing veins in the area is in keeping with this setting.

The mineral occurs in good concentrations in some of the pegmatites and quartz veins and then constitutes over 5% of the rock by volume. It is suggested that detailed prospecting of the rutile-bearing veins may prove workable deposits.

49. Similarity in the Trend of Activities of Components in Metamorphism and Igneous Process.

AMITAVA DUTT, Giridih.

The metamorphic zonal formations and igneous differentiated products called here 'cells' show identical trends in their activity fields. To study them we first constructed the heat distribution curves, according to Schmidt's method, as a function of time and distance inside an igneous body and across the country rock. Thermal conductivity was taken at $6 \times 4.81 \times 10^{-8}$ joules/sec. heat capacity +1.36 joules/sec. distance 1500 metres, density 2.6, distance interval 300 metres, temperature 1000°C . The cool side of the body was taken at 50°C . Some popular but less significant data calculated are—temperature fall in 1355 hours is 75°C and only 15°C in 200 metres at the initial stage but 100°C in same distance at final stage.

Plotting of approximate positions on them showed formations of successive overlapping encrustations around the initial rock at about the same and later period. These encrustations represent the metamorphic and igneous 'cells'.

The 'phase space' comprising all the cells was theoretically constructed as $f(t, p, c)$ ds. This revealed the following successive activities of the components starting from low to high temperature : (Si-Al-Na-K), (Si-Al-Ca-Na), (Si-Al-Fe-Ca), (Si-Al-Mg-Fe), (Si-Al).

Phase Rule analyses also confirm the above.

50. 'The Occurrence of Pyrophyllite in the Schists of Hirakud'.

D. N. RATH, Cuttack.

At the foot of Janira Dungri ($21^{\circ} 32'$, $83^{\circ} 54'$) near Hirakud occurs a thin band of highly foliaceous schistose rocks with reddish white to greenish colours and greasy feel. These rocks show a well-developed schistosity and contortion with a foliation direction roughly parallel to NW:SE. The associated rock types include quartz-sericite schists and schistose quartzites. Under the microscope pyrophyllite occurs as scales with parallel extinction and third order polarisation colours. The quartz grains lie in between the pyrophyllite folias. A Spectroscopic analysis of the rock revealed the absence of magnesium and confirmed the presence of pyrophyllite. The quartz grains are crenulated and exhibit undulose extinction due to lateral movements and crushing. The origin of the pyrophyllite may be attributed to the alteration of the feldspathic constituents and subsequent appearance due to hydrothermal action and shearing movements of the schists. These became feldspathised during the intrusion of the granites which in due course favoured the growth of pyrophyllite.

51. Blank Petrographic Forms for Routine Description of Rocks.

P. G. DOWIE, Madras.

In the preparation of geological reports, the chapter on Petrography has to deal with one important aspect, namely Lithological Characteristics of rocks. For this a large number of hand specimens and micro-sections will have to be examined. So far the author is aware, there is no Blank Petrographic Form suited for this purpose. As such a form will be greatly beneficial to university students, research workers, field geologists and consultant geologists, the author has evolved one. He has also appended another form (copy) with simple instructions for filling in and a third one to show a sample filled in form or report.

52. Development of veins and segregations of anorthite in Calc-silicate rock near Bagalia R.S., Purulia District, W. Bengal.

T. M. MAHADEVAN, Calcutta.

Anorthite (An 94%) forms coarse segregations and small aplitic veins in a band of calc-silicate rock about 2 miles S-W of Bagalia Railway Station ($23^{\circ} 26'$: $86^{\circ} 30'$). The band forms a concordant body in steeply dipping granitised biotite-gneisses which are profusely permeated by potash-felspar pegmatites. The calc-silicate rock consists mostly of diopside (about 70%) and anorthite (An. 94%) (24%) and small amounts of calcite, sphene, scapolite, graphite, biotite and zoisite. In the segregation and veins, which mostly consist of anorthite (An 94) less than 10% is constituted by diopside, scapolite, apatite, biotite and sphene. These, however, form coarse crystals.

The rocks of the area have been metamorphosed under conditions of the granulite facies. The mineral phases in the veins are identical in composition with those in the body of the calc-silicate rock. It is concluded that the segregations and veins have developed as a result of metamorphic differentiation, facilitated by high temperature conditions, which, perhaps, prevailed over abnormally long periods, and the availability of much aqueous solutions from the pegmatites in the enclosing gneisses. Absence of laminated or directional structures in these rocks suggest that direct componental movements had very little influence in bringing about the 'internal differentiation' observed.

53. Chemical Analyses and the Charnockite Series.

C. GUNDU RAO, Bangalore.

Statistical analysis of the associational tendencies in the several oxides with respect to silica in the rocks of the Charnockite Series both in India and abroad has revealed certain important results. The charnockite series of Mysore and of Varburg district, Sweden which have been claimed to be of complex metamorphic origin show associational tendencies of several oxides with silica similar to those observed in normal undoubted igneous suits. The rocks of the Uganda—region, N. Africa, are in disagreement with the oxide distributions found in normal igneous rock series. In case of rocks of the other regions, the results of the present study are consistent with the proposed hypothesis for their origin. If it is suggested that there are no essential differences in the oxide distribution between normal igneous rock series and the granulite facies rocks, then the results of the Uganda rocks are in disagreement with such a view. On the other hand, if it is supposed that there are essential differences in the behaviour of the oxides in these two different group of rocks, then are the Mysore and Varburg rocks really metamorphic?

54. Trend of Differentiation in the Gabbro-Anorthosite Suit of Rocks from Nausahi, Keonjhar District, Orissa.

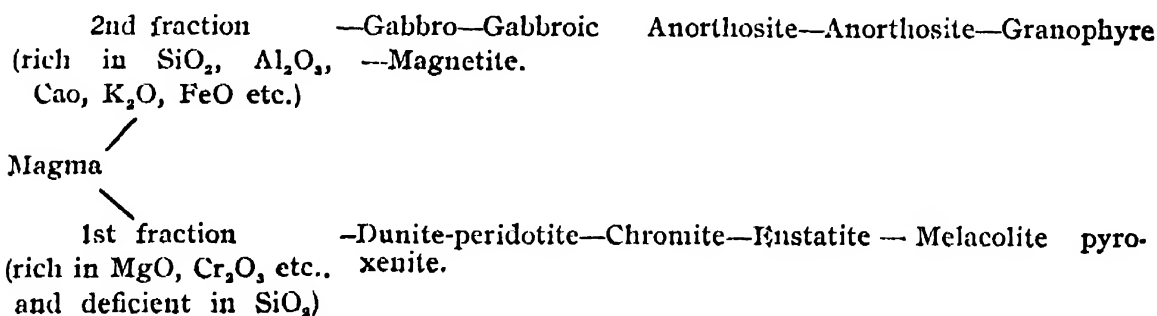
S. DEB and KANAI LAL CHAKRAVARTY, Calcutta.

Regular mineralogical, chemical and textural variation have been found to exist in the gabbro-anorthosite suit of rocks, occurring in the Bula hill range near the village Nausahi ($21^{\circ} 16' 30''$ N : $86^{\circ} 19' 30''$ E), in the Keonjhar district, Orissa. Gabbro-anorthosite suit is composed of the following rock types : Dunite-Peridotite, Enstatite Melacolite pyroxenite, Gabbro (Epidiorite), Gabbroic-Anorthosite, Anorthosite and Granophyre. Besides these chromite and vanadium-bearing titaniferous magnetites also occur in dunite-peridotites and gabbro-anorthosites respectively as late magmatic intrusives. The whole suit was intruded into the archaean quartz-mica schists. The succession have been established, from older to younger, as follows : Gabbro (epidiorite)—Gabbroic Anorthosite—Anorthosite—Granophyre (?)—Dunite-Peridotite—Chromites—Enstatite—Melacolite pyroxenite—Magnetites.

Chemical analyses of the unaltered rocks revealed the regular increase in SiO_2 , FeO , Al_2O_3 , K_2O , CaO , Na_2O etc. and decrease in MgO and Cr_2O_3 from the ultrabasic to the acid variant. The composition of plagioclase varies from $\text{Ab}_{42}\text{An}_{58}$ in melacolite pyroxenite to $\text{Ab}_{63}\text{An}_{37}$ in Granophyre. Microscopic examination showed the presence of olivine, enstatite and chromite in all the three varieties of ultrabasic rocks, and of melacolite in pyroxenite, gabbro, and anorthosites. The textural relation between plagioclase and pyroxene also showed a regular change. Micropegmatites were found in the interstices of gabbro in some cases, which are well developed in the Granophyre.

From the field and laboratory studies the authors came to the conclusion that all the above rock types comprising the gabbro-anorthosite suit of Nausahi, are consanguineous, and were derived from the slightly under-saturated basic magma, from which the magnesium and chromium-rich portion settled down at the first instance to form the ultrabasic rocks. The silica, calcium, aluminium and alkali rich portion, which was left behind, were differentiated in situ to give rise to the basic and acid parts. The ultrabasic rocks were later intruded into the gabbro along the contacts or along locally developed fault zones. The idea of consanguinity was confirmed by the spectroscopic analyses of a few rock samples, which showed the

presence of certain rare elements like chromium, vanadium and scandium in dunite, gabbro and granophyre. The whole magmatic history of the area can thus be summarised as follows :



55. The Field Relationship Between the Charnokites and the Banded Gneisses of the Kondapalle Area.

S. BALAKRISHNA and CH. LEELANANDAM, Hyderabad.

During the course of a detailed field investigation in the Kondapalle area, banded gneisses are occasionally observed in the massifs of the charnokite. Pink and grey varieties of gneisses are noticed in the area, the former predominating the later. The gneisses are often noticed to be associated with pegmatitic intrusions, which generally have a N-S to N.E.-S.W. trend. The contact between the two is not one of knife edge, but all sorts of gradations can be seen from a pure pegmatite through parallel banded gneisses, contorted gneisses and migmatites to a pure charnokite. The gneisses do not have any specific trend and their areal extent is very much limited. It is surmised that the pink and grey banded (granitic) gneisses are produced due to the reaction between pink and grey pegmatitic intrusions respectively with the charnokites. Further it is interesting to observe the gneisses invariably occurring in the vicinity of pink pegmatites, although it is not so common with the grey pegmatites. Further studies in the field and in the laboratory are in progress to establish the relationship between charnokites and banded gneisses.

56. Basic Dykes Around Neral.

R. B. GUPTE, Nagpur.

Several groups of basic dykes occur intruding the Deccan Trap lavas between Bombay and Poona. One of these, consisting of twelve dykes occurs around Neral (Dist. Kolaba, Bombay). The dykes run in two main directions approximating to E-W and N.E.-S.W. Most dykes outcrop for short distances only ranging from a couple of hundred meters to a little over a kilometer. Only the large ones which occur as spines of hills and ridges are exposed over several kilometers. They range in thickness from half a meter to 40 meters and some dykes show variations in thickness when traced laterally. All have developed prismatic jointing. Except one dyke which is a typical medium grained dolerite, all resemble compact basalts. Some are very fine grained and nonporphyritic. Others show porphyritic texture with phenocrysts of plagioclase in an aphanitic groundmass. Size and number of phenocrysts vary from dyke to dyke. Usually marginal portions are finer grained and contain a smaller number of smaller phenocrysts than central portions. Under the microscope they show typical basic composition with labradorite, monoclinic pyroxene, fresh and altered olivine, and iron ore. In most cases age relationship is not clear, intersections of dykes being concealed by superficial deposits.

57. A Petrochemical Note on the Granitic Rocks of Singhbhum and Adjacent Areas.

AJIT KUMAR SAHA, Calcutta.

A critical review of the available mineralogical-textural data and 12 chemical analyses reveals striking mineralogical, textural and chemical contrasts between the Singhbhum granite on the one hand, and the biotite granite-granophyre of South Dhalbhum, soda granite-granophyre along the copper belt thrust zone of Singhbhum, on the other. The Singhbhum granite is characterized by the presence of epidote as constant accessory, relatively high proportion of CaO, normative and modal quartz below 30%, scarce magnetite, and absence of any copper minerals. The soda granite-granophyre-biotite granite group of rocks contains a fair proportion of magnetite as constant accessory, normative quartz over 30%, occasional copper minerals, a smaller proportion of CaO and no epidote. The Niggli values, c/fm and alk for the two groups of granites, when plotted against the si values, lie in two separate series; for the same si value, the Singhbhum granite has distinctly higher c/fm and alk values.

Lack of any gradation between the two groups of granites and the tendency of some of the variations within the two groups to lie in distinct series favour the possibility that the emplacement of Singhbhum granite and that of the soda granite-granophyre-biotite granite groups occurred in separate orogenic periods.

58. On the Nature of the Basic Inclusions in the Nepheline Syenites of Mount Girnar Saurashtra.

S. C. CHATTERJEE, Patna.

In this paper the microscopic characters of the basic inclusions in the Girnar nepheline-syenites have been described. These are of the following two types:—Hypersthene granulites, Hornblende-gneiss.

The nature of the inclusions suggests a much older age for the Girnar massif than the supposed post-Deccan Trap age. It is suggested that the rocks may be of the same age as those of the Mundwara ring complex.

59. Predictability of the Sequence of Mineral Formation on the Basis of some Statistical Mechanical Principles.

AMITAVA DUTT, Giridih.

When a system of known components cooling from high to low temperature under constant total pressure and total concentration is left undisturbed by any external agencies it tends to attain equilibrium conditions in time according to Boltzman's H-theorem.

A relation showing the probable value of the total energy of such a system was first obtained. It was then further deduced to show the variations of activities of the components in a cooling condition as a function of time. The equilibrium distribution law of Fermi-Dirac was applied. The final mathematical relation broadly suggests the following: (1) the probability is that the activity range of higher N/Vm_0 components will be shorter and relatively more inert (N-Valency electron, V-Volume, m_0 —mass of electron). (2) the chance of finding the system in a given range will be high for the high N/Vm_0 components.

The range of activity somewhat determines the differentiation products. The above observations suggest that relative inertness of components, the sequence of formation and the stability of minerals may be guided by N/Vm_0 values, of the participants. They somewhat conform to what we actually note in igneous differentiation products and to some extent in metamorphic zonal tendencies.

59A. A Note on the Grindability Tests of the Karo Seam in the East Bokaro Coalfield, Bihar.

S. M. CASSHYAP, Aligarh.

The Karo seam is an important coal seam of the East Bokaro coal-field. It belongs to the basal part of the Barakar formation of Gondwanas.

Some grindability tests have been performed on the coals of Karo Seam, following the standard Hardgrove method. Determinations of proximate analyses on the same samples have also been carried out in order to correlate the Hardgrove Grindability Index with their chemical constituents.

The coals of Karo seam are low in moisture. They are medium volatile coals and are slightly richer in ash content. The Hardgrove Grindability Index (HGI) for these coals varies from 60 to 78. There is a tendency for the HCI to decrease with increase of both the moisture as well as the volatile contents. Similar relationship with ash does not appear to be very distinct.

With this range of Grindability Indices it may be suggested that the coals of Karo seam in general are of medium rank and also that they can be subjected to pulverization without much difficulty.

SEDIMENTOLOGY**60. "Size—Parameter of the Tura Sandstone, Assam".**

D. N. D. GOSWAMI, Gauhati.

The mechanical analysis of the Tura sandstone are represented by the help of the cumulative and frequency curves. The size parameters are the quartile measures, moment measures, measures of dispersion and skewness and kurtosis. The scale is used.

Quartile measures show that the median diameter varies from 0.25 to 0.35 mm. and the sediments are well sorted. The quartile skewness is within the range of 0.05 to 0.10 towards left in the scale.

The most frequent diameter of the distribution and the centre of gravity are .25 mm. and .25 to .42 mm.

The range of the spread lies within 0.2634—0.220 mm.

The sandstone is skewed within the range of 0.0194 to 0.1035 mm. As the value of the kurtosis, that is $B_2-3 = +ve$, the sandstone is leptokurtic.

61. On some sedimentary structures in the dolomites in the Almora district, Uttar Pradesh.

M. R. SUBRAMANYAM and R. S. JAIN, Calcutta.

During the geological mapping of parts of the Almora district some interesting structures have been noticed in the dolomites.

The dolomites form part of the Garhwal Series and are exposed as thrust blocks or sheets, overlying slates and shales, and overthrust by quartzites, in a tectonic window bounded by later thrusts.

The light grey coloured, fine grained and locally cherty and brecciated dolomite show characteristic banding with alternating silicious layers. At places these silicious bands curve round to form rings which stand out prominently on weathered

dip slopes. The rings vary in diameter from 3 to 10 centimetres and are regular and closely spaced. In cross section, at right angles to the bedding, the appearance is like that of a pile of saucers in vertical columns separated from neighbouring columns by silicious filling, simulating healed slip planes.

The structure appears to be a pene-contemporaneous sedimentary feature, perhaps later modified by deformation. They are somewhat similar to the "convolute" bedding described by Kuenen and others.

The structures are significant in that they suggest the dolomites to be a clastic rather than a chemical deposit, and they indicate correct tops of the beds since the concave sides must be top facing during deposition.

62. On Gravel Deposits from Baripada, Mayurbhanj District, Orissa.

G. C. CHATERJI and P. G. ADYALKAR, Calcutta.

Good deposits of gravel suitable for use in shrouding tubewells occur in the Sadar subdivision of Mayurbhanj district, Orissa. Three of these deposits which are economically more important cover a total area of about 1.60 square miles. They are located on the north-east, east, and east-south-east of Baripada town ($21^{\circ} 56' : 86^{\circ} 44'$; 73-K/9) within a radius of six miles. In these three deposits the reserves of the more commonly required size grades, $1/16''$ to $3/8''$, has been estimated at 40 million cubic feet. Deposits of minor significance are located in the Kathagandia State Reserved Forest as well as near the villages of Baisinga ($21^{\circ} 39' : 86^{\circ} 55'$; 73-K/14) and Saramala ($21^{\circ} 46' : 87^{\circ} 03'$; 73-0/1). All these deposits have been assigned a Plio-Pleistocene age.

63. Notes on Sand dunes of Balasore Coast.

H. N. SIDDIQUIE, Calcutta.

The paper presents the results of a study of twenty samples of dune sand collected from different localities in the Balasore Coast

It is possible to distinguish series of sand dunes old and new, in the sand dune belt of Balasore.

All the dune sands are well sorted, their coefficient of sorting ranging from 1.2 to 1.4, skewness 0.74 to 1.81, kurtosis 0.19 to 0.27. The older dune sands can be distinguished from the newer dune sands by their coarseness, median size in the case of former is $1/8$ mm. and in the latter $1/16$ mm.

The specific gravity of the dune sand varies from 2.6 to 3.31, depending on the percentage of magnetite and total heavy minerals, which vary from 0.6% to 41%. There appears to be a tendency for the heavy minerals to be concentrated on the leeward side. Also on a regional basis the concentration of heavies increased towards the west. Samples showing negative skewness have a higher percentage of heavy minerals.

The non-opaque heavy minerals are kyanite, sillimanite, andalusite, staurolite, tourmaline, epidote, zircon and garnet, which suggest their derivation from a high rank metamorphic terrain.

The extension of the sand dunes over a wide belt in the Balasore district can be explained by the regression of the sea in stages which led to the formation of different sets of dunes.

64. Subsurface Geology and Tectonic Framework of Sedimentation in the Crescentic Coastline off Balasore (Orissa).

G. C. CHATTERJI and K. V. RAGHAVA RAO, Calcutta.

This paper discusses the investigations on the subsurface geology of the country adjoining the crescentic coastline of Balasore. Materials for the study were collected during exploratory drilling operations in Orissa.

Besides the known alluvial, deltaic and littoral environments of deposition, the study has brought to light epineritic and infraneritic marine environments in a roughly five-mile wide belt of which the upper fringe lies about three miles east of the crystalline outcrops of the area.

The sediments associated with the marine environments are characterised by bluish gray, greenish gray and dark gray clays, sand sheets and bands of gray fine grained limestones rich in benthonic invertebrate fauna (brachiopods, molluscs and corals). The clay beds associated with and overlying the limestone bands, contain vertebrate fauna (fish teeth).

On the basis of the lithogenetic studies,—the organic controls still to be completely worked out, the areno-argillaceous members, characterised by the fossiliferous limestone partings are tentatively correlated with the Minnagalkanda Miocene formations on the southeast coast of Ceylon. Mottled and brown sandy clays deposited on the marine sediments in a few places, are correlated with the clayey sandstone facies of the Cuddalore and Rajahmundry formations. Well defined but inconsistently spread horizons of subrounded gravel are superincumbent on the above. These are met with at depths less than 300 feet and are tentatively considered to be Pliocene or later in age.

Following the classification of tectonic elements adopted by Kuenen, the authors postulated a 'Nuclear Basin' along the eastern fringe of the Chota Nagpur Plateau, which governed the sedimentation in this belt during the Tertiary Era. The extension of the same depression into the crescentic bay off Balasore, facilitated quiet marine environmental sedimentation in the Miocene period, and later estuarine sedimentation.

65. Sedimentary Boudinage Structures in the Narji Limestones of Kurnool System.

K. V. G. K. GOKHALE and T. C. BAGCHI, Kharagpur.

Lenses of siliceous material have been observed along the bedding planes in the Narji limestone, near Kalava ($15^{\circ} 37'$; $78^{\circ} 12'$). The lenses show pinch and swell structures and resemble boudinage structure. Such structures have been reported in past, in different limestones and shales [Newell et al (1953); Osmond (1956); McCrossan (1958)]. The present discussion comprises a detailed account of the structures exhibited by the siliceous layers within Narji limestone, with a probable explanation of their formation.

The boudins, at places along their margins, are bounded by small vertical cracks which are filled in by calcareous material. On the surface, the lenses show tensional cracks, which might be formed due to the friction at the interface during flowage of the calcareous material, and its drag against the comparatively coarse grained less plastic siliceous layer. The authors are the first to report such structures in Narji limestones of Kurnool System. From the laboratory and field evidences, it is believed that the siliceous material has been deposited as thin layers sandwiched between the calcareous sediments and is pulled apart by the laterally moving plastic limestone, when subjected to compaction. Continued compaction and penecontemporaneous deformation have later modified these structures. This idea is further supported by the characteristic absence of replacement features in the siliceous layers within the limestone.

66. A note on the mottled limestone of Gupteswar, Koraput, Orissa.

S. ACHARYA, Cuttack.

The author had the opportunity of visiting the Gupteswar caves of Koraput district, Orissa. It is situated at a distance of twelve miles from Baipariguda which is on the Jeypore-Malkangiri road. The rocks of this region consist of limestones, shales, and quartzites the first two being more common and they all are of cuddapah age. The Gupteswar hill is entirely of limestone and has caves where stalactites and stalagmites have formed and one of which is worshipped as Lord Shiva. The limestones, older than the Gupteswar one, is separated from it by a ferruginous shale of about 100' thick. This older limestone which is best developed at Sirivada is conspicuous by its mottled structure that is present throughout the entire length and breadth of it. This limestone has a much higher MgO content than Gupteswar limestone and this seems to be due to dolomitisation. An attempt has been made as to the factors those might have helped dolomitisation.

67. Microstylolites in Vindhyan Sandstone.

S. M. MATHUR, Calcutta.

Some microstylolites were noted for the first time in the quartzite belonging to the Lower Rewa Sandstone formation of the Upper Vindhyan System. In hand specimen the stylolites appear as ferruginous streaks running across the quartzite. Close examination under a hand-lens shows that these streaks are wavy, and in thin section under a microscope they appear as typical stylolite seams. The pressure-solution theory of stylolite formation applies in this case also.

68. An unusual occurrence of Selenite in the Alluvium of the Jalaun District, U.P.

S. M. MATHUR, Calcutta.

Gypsum has been reported in the past to occur at several localities in the various of streams flowing through the alluvial plains of a few Bundelkhand districts, at shallow depths. However, the author here reports some occurrences of selenite variety of gypsum at depths ranging up to 275 feet in the alluvium of certain localities in the Jalaun district quite far away from stream causes. In a tube well sunk in Orai town, gypsum was brought up by the drill from about 250 ft. depth from the surface. In a dug well at Ata village, clear selenite crystals were obtained in abundance upto a depth of 105 feet. It is suggested that selenite may have been formed by authigenic growth in the alluvium, which may represent here the shore clay of a salt water sea or lake in the geological antiquity. The simple explanation of earlier observers that the gypsum in clay was formed by the action of water containing sulphuric acid reaching on the carbonate of lime in the alluvium, does not appear to hold good in the present case.

69. Turbidites and Sedimentary Structures from the Chaibasa Stage, Iron-ore Series (Singhbhum District, Bihar).

S. M. MATHUR, Calcutta.

The Chaibasa stage of the Iron-Ore series in the Singhbhum district has been described by previous workers as being composed predominantly of mica- and hornblende-schists. However, recent examination by the author of some sections

near Rakha Mines and Ghatsila has shown that the bulk of this formation is composed of graywacke together with interstratified mica-schist. Hornblende-schist is actually absent or present in very small quantity in the outcrops examined. The graywacke is full of sedimentary structures that are formed by the action of turbidity currents. These structures are being reported for the first time. Graded bedding is commonly observed. Examples of convolute laminations, slump structures, load-casts, fine current ripples, scour-and-fill structures are extensively seen. The discovery of these graywacke and sedimentary structures throws new light on the structure, palaeogeography and metamorphism of the rocks of this area.

ECONOMIC GEOLOGY

70. Geology, wall-rock alteration and paragenesis of sulphide ores of Daribo Copper Mines, Rajasthan.

J. K. PARIKH, N. V. R. SUBRAHMANYAM and K. R. RAGHU NANDAN,
Dhanbad.

The paper embodies the underground geology of Daribo ($27^{\circ} 10' : 76^{\circ} 27'$) Copper Mines in Rajasthan. The rock units and mineralisation have been studied after detailed mapping of three adits. The rocks which are exposed in the area belong to the Delhi System and overlie those of Aravalli System. Arkose, quartzite, calcareous phyllite and impure limestone are the main rock types which are isoclinally folded into Baldcogarh anticline.

Daribo copper deposit is an epigenetic, hydrothermal and fissure-filling type of post-Delhi age. The lodes consist of solid copper sulphide veins of lenticular shape and *en echelon* pattern. The lithological and structural control of copper mineralisation can be attributed to the calcareous phyllites which were highly sheared and traversed by strike faults.

The first onset of mineralisation is seen in the wall-rock alteration of the host rock in a zone of varying thickness. Prominent minerals of this zone, in order of paragenesis, are: biotite, scapolite, tourmaline, apatite, magnetite, sphene and quartz. Profuse development of crystalloblastic scapolite and medium-grained sphene is a feature suggestive of a unique physico-chemical environment. The hypogene sulphide mineralisation, which followed the wall-rock alteration, resulted in the formation of pyrite, pyrrhotite, chalcopyrite, bornite and quartz in order of their paragenesis.

71. Reserves of Sand in the Damodar and Ajay Rivers within the Jharia and Raniganj Coalfields for Stowing in Collieries.

S. BANERJEE, Calcutta.

Drilling for sand, as requested by the Coal Board, in the Damodar and Ajay rivers within the Jharia and Raniganj coal-fields was undertaken by the author to prove the reserve of sand deposits in them for stowing in collieries.

During 1958, a sand reserve of 38.2 million tons has been estimated in the Damodar river in the Jharia coalfield between Longs. $86^{\circ} 11'$ and $86^{\circ} 20'$. According to Messrs. Bird & Co. the reserve is about 140 million tons between Longs. $86^{\circ} 20\frac{1}{2}'$ and $86^{\circ} 35\frac{1}{2}'$. Thus the total quantity of sand available in the Damodar river between Longs. $86^{\circ} 11'$ and $35\frac{1}{2}'$, covering practically the whole length of the Jharia coalfield comes to 178 million tons. According to the Coal Board, present average annual consumption of sand for stowing purposes in Bihar collieries is

about 1.55 million tons. But the total annual need of sand for Jharia coalfield may be as high as 20 million tons, whereas the annual replenishment of sand to the order of 11 million tons may be expected from the Damodar river in this region.

A reserve of 580 million tons of sand (including 10% clay beds) in the Damodar river from its junction with the Barakar river to Pinjrapole ($23^{\circ} 33' : 87^{\circ} 14'$) in the Raniganj coalfield had been estimated by G. S. I. during 1946-48. Recent sand survey by the author in 1957-58 indicates 224 million tons of sand (excluding clay beds) in the Damodar river bed between Longs. $87^{\circ} 7'$ and $11'$, and $87^{\circ} 15\frac{1}{2}'$ and $17\frac{1}{2}'$. It has been noticed that the thickness of the sand bed in the above area has been increased by three feet since 1946-47, having an annual replenishment of sand to the order of 10 million tons.

290 million tons of sand reserve (including 30% clay beds) in the Ajay river between Longs. $87^{\circ} 03'$ and $21\frac{1}{2}'$ were estimated by G. S. I. in 1946-47. A sand reserve of 90.5 million tons (excluding clay beds) has been found during 1957-58 in the Ajay river between Longs. $87^{\circ} 08'$ and $13'$ and $87^{\circ} 15\frac{1}{2}'$ and $17'$.

Total sand reserve in the specified portions of the Damodar and Ajay rivers in the Raniganj coalfield comes to about 1074 million tons; and the present annual consumption of sand for stowing purposes in West Bengal is about 3 million tons.

72. Titanium Ores Around Gaurangdih, Purulia District, W. Bengal.

PRIYA RANJAN SEN GUPTA, Calcutta.

The titanium ores occurring in pegmatites and quartz veins around Gaurangdih ($23^{\circ} 26' N : 86^{\circ} 46' E$), Purulia Dist., West Bengal, comprise rutile as the major constituent with a considerable amount of ilmenite. Ilmenite ($DR_F = v \rangle r$, Λ_F : Blue = 3° , White = 2° , Red = 1° , $DA_F = v \rangle r$) and rutile occur in granular aggregate. Magnetite occurs associated with ilmenite (1) as abnormally thick and wide plates arranged parallel to (0001) planes of the latter, and (2) as discrete subhedral and anhedral grains, and never occurs with rutile. Both the types are of the same generation and one is often found to pass into the other. Typical mineral assemblages are : (1) rutile; (2) rutile-ilmenite; (3) ilmenite; (4) ilmenite-magnetite with some secondary haematite.

Evidences have been placed to show that the ilmenite has crystallised from an interstitial liquid after the separation of the major bulk of rutile. It has been suggested that crystallisation started from a liquid rich in titania. With the separation of rutile, and the concomitant rise in the relative percentage of iron (mainly Fe^{2+}), a point reached when ilmenite started precipitating. The whole of magnetite with its necessary Fe^{3+} content, trapped before in ilmenite, was exsolved out of it in the later phase of protracted cooling.

73. New Occurrence of Vermiculite near Kubri, Hazaribagh District, Bihar.

S. N. P. SRIVASTAVA, Calcutta.

While carrying out systematic geological mapping in the Survey of India topographic sheet 72 H/15, the author came across an occurrence of vermiculite lying just east-north-east of the village Kubri ($24^{\circ} 16' : 85^{\circ} 59'$). The vermiculite occurs in an area about 670 yards by about 350 yards. It is associated with pegmatites, quartz veins and hornblende schists occurring in granite gneisses. There are two main veins of the vermiculite running parallel to each other. The largest one is about 1,800 feet long and has an average width of about $3\frac{1}{4}$ feet, the maximum width

being 7 feet 2 inches. The second one is about 1,190 feet long and $2\frac{3}{4}$ feet wide, the maximum width in this case being 9 feet 3 inches. The exposed depth is about 5 feet. The largest size of the vermiculite book is 3×2 inches square.

When suddenly exposed to heat in an electric furnace at 800 degree centigrade the linear expansion, on average, of a few samples of the vermiculite, is little over $8\frac{1}{2}$ times the original. The maximum expansion is up to 20 times the original. The dark bronze or greenish bronze colour changes to silvery white at the above temperature.

The occurrence is connected to both Giridih and Kodarma by *Kulcha* and pitch roads. The area appears to be promising and merits further attention.

74. New occurrences of Calc-Tufa around Mahulbasa, Singhbhum District, Bihar.

S. N. P. SRIVASTAVA, Calcutta.

While carrying out the detailed examination of asbestos in Bihar, the author came across two occurrences of calc-tufa: one lying at about half a mile north of Mahulbasa ($22^{\circ}51':86^{\circ}19'15''$) and the other on the southern flank of Chhagaltopa *pahar* ($22^{\circ}51':86^{\circ}20'$). They are associated with either epidiorites or amphibolites. Each of the deposits runs east-south-east to west-north-west. The calc-tufa at Mahulbasa is about 75 feet long and about 50 feet wide extending now to a depth of about 30 feet. The occurrence at Chhagaltopa *pahar* is about 100 feet long and 30 feet wide with an exposed depth of about 50 feet. The colour of tufa is either earthy, greyish blue, white or reddish.

The results of the chemical analyses are as follows:

Locality		SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Loss	Total
Mahulbasa ...	...	2.62	1.64	0.76	50.90	2.02	41.74	99.69
Chhagaltopa <i>pahar</i> ...	...	1.48	0.92	0.28	52.35	1.70	42.24	98.97

The above results are very encouraging. The adjacent areas merit further attention with a view to locate some more occurrences of calc-tufa.

75. Structural control and ore mineralisation in Gani copper belt, Kurnool district, Andhra Pradesh.

P. SATYANARAYANA RAO, Calcutta.

Detailed structural mapping of Gani copper belt in Kurnool district, Andhra Pradesh was carried out to study the structural controls for copper mineralisation and their relation to the geophysical anomalies obtained in the area previously by geophysical surveys.

Rocks of the lower Cuddapah Tadpatri shales and associated basic intrusives (meta-dolerites) occur in the area overlain unconformably by Banganapalle Sandstones, Jammalamadugu limestones and Panyam quartzites of Kurnool system. The geological structure is an asymmetrical anticline plunging at low angles towards N80E. There are clear evidences for pre-Kurnool folding of the underlying Cuddapah rocks. Evidences are found for later refolding of the axis of the anticlinal fold resulting in dextral and sinistral drag folds. This drag folding has resulted in lowering of dips and consequent widening of the outcrops of the Kurnool beds along the drag fold axes, and steepening of dips and narrowing or disappearance of some of the beds in between the drag folds along the steep northern limb of the anticlinal structure. The latter are areas of shear faulting. These faults diverge and cut

across into the Tadpatri shales roughly in ESE direction, parallel to the axes of the sinistral dragfolds.

Surface indications for copper are rather poor. They consist of a number of shallow old workings confined mostly to the contact of Tadpatri shales and basic intrusives. Occasional disseminations of chalcopyrite and liberal coatings of secondary carbonates, malachite and azurite, are seen in the shales, basic intrusives and quartz veins exposed in the old workings. Quartz veins are the main carriers of chalcopyrite. They are disposed in an en-echelon pattern.

The en-echelon pattern of the mineralized zones south of Kalava, Brahmanapalle, and Gani indicates that ESE trending en-echelon faults resulting from drag folding of the regional anticlinal fold, have acted as the regional structural controls for one mineralization. Tension fractures developed in the vicinity of the faults at and near the contact of Tadpatri shales and basic intrusives are the loci for the copper mineralization.

76. Petrological and Thermal Studies of some Bauxite samples from Shahdol Dist., Vindhya Pradesh.

S. BANERJEE, Calcutta.

Physical, chemical and microscopical studies of some bauxite samples from Shahdol district, Vindhya Pradesh reveal the predominant presence of the bauxite mineral gibbsite in them. Other minor mineral constituents are ilmenite, rutile, magnetite, hematite, and limonite. Greyish white cores of the pisolites consist mainly of fine laths and plates of gibbsite crystals (av.R.I.—1.579 : $Z \wedge C-22^\circ$: Brief-low : elongation+) and/or cryptocrystalline aggregates of them. Differential Thermal analysis of one sample shows a strong endothermic dehydration reaction-peak at 340°C indicating the presence of gibbsite (Plate No. 1). Chemical analyses of three samples shows:— Al_2O_3 varying between 40.86% and 63.16%; SiO_2 between 0.82% to 1.70%; Fe_2O_3 between 3.08 to 27.75%; TiO_2 between 6.17% to 10.00%. The samples are titania rich, low in silica. One of the three samples analysed shows high percentage of Fe_2O_3 (27.75%) and low content of Al_2O_3 (40.86%). Other two samples are moderately rich in alumina and do not contain iron oxide and silica beyond objectionable limit for aluminium manufacturing. These are not suitable for chemicals and refractory purposes at present as per specifications laid down for them (for high content of iron and titania). The two samples which show suitability for aluminium manufacturing are taken from Parhamdadar, Shahdol district, Vindhya Pradesh.

77. Geology, wall-rock alteration and paragenesis of sulphide ores of Daribo Copper Mines, Rajasthan.

J. K. PARIKH, N. V. R. SUBRAHMANYAM and K. R. RAGHU NANDAN,
Dhanbad.

The paper embodies the underground geology of Daribo ($27^\circ 10' : 26^\circ 27'$) Copper Mines in Rajasthan. The rock units and mineralisation have been studied after detailed mapping of three adits. The rocks which are exposed in the area belong to the Delhi System and overlie those of Aravalli System. Arkose, quartzite, calcareous phyllite and impure limestone are the main rock types which are isoclinally folded into the Baldeogarh anticline.

Daribo copper deposit is an epigenetic, hydrothermal and fissure-filling type of post-Delhi age. The lodes consist of solid copper sulphide veins of lenticular shape and *en echelon* pattern. The lithological and structural control of copper mineralisation can be attributed to the calcareous phyllites which were highly sheared and traversed by strike faults.

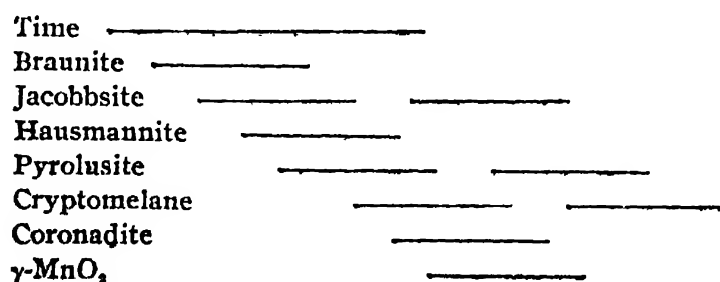
The first onset of mineralisation is seen in the wall-rock alteration of the host rock in a zone of varying thickness. Prominent minerals of this zone, in order of paragenesis, are: biotite, scapolite, tourmaline, apatite, magnetite, sphene and quartz. Profuse development of crystalloblastic scapolite and medium-grained sphene is a feature suggestive of a unique physico-chemical environment. The hypogene sulphide mineralisation, which followed the wall-rock alteration, resulted in the formation of pyrite, pyrrhotite, chalcopyrite, bornite and quartz in order of their paragenesis.

78. Mineralogy and Texture of the Manganese Ores of Kodur, Srikakulam District, Andhra Pradesh, India.

SUPRIYA ROY, Jadavpur.

The mineralogy of the manganese ores of Kodur group of mines (Kodur, Garividi, Devada, Duvaam and Sadanandapuram), Srikakulam Dt., Andhra Pradesh has been investigated in detail by study of polished sections under reflected light and X-ray powder analysis of the individual minerals. The following minerals have been conclusively identified from the ores: braunite, jacobsite, hausmannite (and the mixed mineral vredenburghite), pyrolusite, cryptomelane and γ -MnO₂. Subhedral to euhedral braunites are the most abundant primary minerals. Jacobsites are present both as individual grains which form pseudomorphic replacement of Mn-garnet, and also in intergrowth with hausmannite. The cell dimension of jacobsite varies from $a=8.410\text{\AA}$ to $a=8.506\text{\AA}$ and the optical characters and etch characteristics of the mineral varies with it. Those with lower cell dimensions conform more to the magnetites in optical characters and etch reactions. Hausmannite is found in this suite only as exsolution lamellae in jacobsite. Pyrolusite is present as interstitial grains in braunite, as rims around vredenburghite or as secondary alteration product. Cryptomelane, coronadite and γ -MnO₂ exhibit colloform texture and are among the late minerals of the suite.

Interesting textural features have been noted in this suite of ores. Braunite, in euhedral to subhedral grains, was the earliest formed primary mineral whose interstices the vredenburghites later occupied. Hausmannite exsolved in jacobsite to form vredenburghite at lower temperature pressure condition. Pyrolusite is interstitial in braunite, rims vredenburghite and is also present as secondary mineral. Colloidal gel, rich in Ba, K and Pb, invaded the ores after primary consolidation and cryptomelane, coronadite and γ -MnO₂ were deposited in pore spaces. Cryptomelane also occurs as secondary alteration product. The paragenesis of the ore minerals may, thus, be drawn as follows:—



79. Hydrothermal Alteration of the Wall-rock in the Mosabani Copper Mine, Singhbhum, Bihar.

S. DIB and S. C. SARKAR, Jadavpur.

Three distinct zones of hydrothermal alteration have been found out in the Mosabani Copper Mine, Singhbhum. But the observations are limited to a width of about 120 ft. in the hangwall side and about 500 ft. in the foot-wall side along cross-cuts driven in the 18th and 20th levels respectively.

The innermost zone with which the copper mineralisation is directly associated is that of sericitisation, characterised by the development of much muscovite and sericite. It is about 120 ft. (fullest accessible width) in the hangwall side. In the foot-wall side it is followed by a 125 ft. wide zone of propylitisation characterised by the development of much chlorite, epidote and zoisite. After this, a sericite zone of about 40 ft. width is repeated followed by a 100 ft. wide propylitic zone. Beyond this second propylitic zone is the zone of actinolite-biotite schist.

So there are two sericitised zones, one 150 ft. wide and another about 10 ft. in width parallel to it. The first one marks also the places of maximum fracturing and tensional dilation. Copper ore mineralisation is confined within this zone. In future ore-search in this portion of the belt, a wide sericitised zone in association with maximum fracturing and tensional dilation may be sought as the possible loci for copper ore mineralisation.

80. Ore—Microscopic Studies of Iron Ores of Bailadilla Range, Bastar District, M.P.

A. CHATTERJEE, Kharagpur.

During the course of a detailed investigation of the Iron-formations of Bailadilla Range, Bastar Dt., M.P., mineralogical, textural and paragenetic aspects of the iron ores have been studied under ore-microscope. The iron ores occur as enriched members of the banded iron formation of the Bailadilla Iron Ore Series of Crookshank (1938) and some important occurrences can be traced towards the junctions with the lower ferruginous schist member, which towards the eastern flank of the range is characterised by magnetite-martite, quartz and an Fe-amphibole (grunerite and riebeckite, Nx-1-673, Nz-1-683, XAC-90) and a well developed thin bedding schistosity. Ore-microscopic studies of the ores of some of the important occurrences reveal the presence of several distinct petrological types :—(1) A widely occurring massive ore consisting almost entirely of fine interlocking grains of hematite, (2) A laminated ore characterized by sharp alternating laminae of hematite of differing grain sizes with rare traces of unreplaced silica occurring at the contacts. Tongues from the laminae of finer grain may invade those of the coarser ones which may indicate the former to be of later origin. The type presents interesting structural features in the form of faults often of the reverse types arranged in steps and microfolds, (3) A banded type consisting of bands of slightly elongated ooliths and spherulites of goethite, brown limonite and doubtful carbonate alternating with those of euhedral martite grains. (4) A banded magnetite martite ore, occurring at the eastern flanks of the Bailadilla Range (an average modal composition of magnetite 13.23%, martite 55.09%, goethite 11.30%, later hematite 10.01%, and brown limonite 10.37%). Besides the ore minerals mentioned above lepidocrocite, and fine cubes of pyrite in association with brown limonite have also been identified. Two stages of goethitization can be deciphered in almost all the types of ores. In the earlier period, it starts from the grain boundaries of magnetite-martite and almost overlaps the period of martitization in time sequence, while in a later period, goethite extensively replaces earlier minerals in the form of veins or layers and

is marked by automorphic crystallization of the fine needles of hematite along the borders.

Summing up, at least in one type Fe-hydroxides and possibly a little carbonate were certainly formed during primary deposition. Excepting that, at least three stages of formation of hematite separated by two stages of goethitization and an earlier period of crystallization of magnetite can be traced in the different types.

81. A note on the fluorspar occurrences at Chapoli, Jhunjhunu district, Rajasthan.

S. P. DAS GUPTA, Calcutta.

The paper records the occurrences of fluorspar veins, irregular patches and disseminated crystals in the sheared pegmatite and granite from the east of Chapoli (27°44' : 75°36') in the neighbourhood of Mrindala and Balwara dhanis, and Babai (27°53' : 75°49') in the district of Jhunjhunu, Rajasthan. There are two kinds of deposition viz. (1) fissure filling and (2) replacement. In the fissure fillings there is a suggestion of colour zoning which ranges in tinge from slightly bluish through various shades of violet, purple, green to clear and colourless variety but there is no regularity of colour zones in the order of deposition. In the shear zones where replacement is dominant over fissure fillings no such colour zoning is clearly discernible. Fluorspar veins are mostly controlled by moderately dipping E-W, NW-SE, NE-SW, and N-S joints and fractures. Sometimes the intersections of the two sets of joints exert considerable influence over the pitch of smaller fluorspar bearing ore shoots. The width of the vein usually varies from a fraction of an inch to six inches or more but on the average it is 1½" only. The dominant mineral commonly associated with fluorspar is quartz which is last to crystallize. Calcite is rarely noticed. In general, fluorspar content diminishes with depth and its place is taken by quartz or the joint planes are barren, although the openings may exist downwards. The gouge material or kaolin in the shear zones and joints have probably acted as a barrier to the migrating mineralising solutions which while travelling got deposited in the fissures and shear zones. The deposit is thought to be of hydrothermal origin and genetically related to the last phase of granitic liquid. Probably the original solution rich in fluorine while passing through the granite reacted with calcium of plagioclase with the formation of calcium fluoride.

82. On the Origin of the Manganese Ores associated with the Gondites of Old Madhya Pradesh.

S. P. DESHPANDE, M.Sc., Nagpur.

Sir L. L. Fermor believed that though a part of the manganese ores of this region has been formed by the direct compression of the original manganiferous sediments, an important part of it was formed by subsequent alteration of the gondite in Archaean times. The author, on the other hand, believes that all the ores are a product of metamorphism and the alteration of gondite did not play any role in their formation. The evidences in favour of this belief are :

(1) Deeper exposures of gondite are always unaltered.

(2) Psilomelane, which the author believes to be a weathering product, is found only in the upper layers of the deposits. If it was formed in part, as Fermor believed, by the alteration of gondite in Archaean times, we should find it in abundance at any depth.

Fermor has also made the above two observations in those deposits which had attained some depth at that time.

(3) Braunite and Psilomelane, which according to Fernor are in part products of this alteration, exhibit different textures and modes of formation. While Braunite occurs as a primary metamorphic mineral (never veining gondite), Psilomelane occurs as numerous veinlets veining and replacing all the associated minerals and rocks including gondite.

Palaeontology

83. Foraminifera from the Miliolites of Saurashtra.

V. V. SASTRI and S. C. PANT, Calcutta.

While carrying out coastal geological survey of Saurashtra in connection with the study of eustatic changes of sea level along the Indian coast, the authors have examined the well known Miliolite rocks at Adiatiana ($21^{\circ}43':69^{\circ}41'$) near Porbandar ($21^{\circ}38':69^{\circ}37'$). Dr. H. Carter (1857) named this group of rocks as Miliolites on the supposed predominance of foraminifera belonging to this family Miliolidae. Our present study of the microfauna of these rocks show that the Miliolidae are a minority in the fossil assemblage. The following foraminifera are identified:—

Quinquiloculina tricarinata (d'Orbigny); *Q. seminulum* (Linnaeus); *Q. venusta*, Karrei; *Triloculina* cf. *conica* d'Orbigny; *Modosaria* sp. *Nonion scapha* (Fichtell and Moll); *Elphidium crispum* (Linnaeus); *Bolivina* sp.; *Loxostomum* cf. *limbatum* (brady); *Chrysalidinella dimorpha* (Brady); *Gyroidina soldanii* d'Orbigny; *Streblus calcar* d'Orbigny; *Streblus beccarii* (Linnaeus); *Streblus papillosus* (brady); *Streblus dentatus* (Parker and Jones); *Amphistegina lessonii* d'Orbigny; *Globigerina bulloides* d'Orbigny; *Globigerinoides triloba* d'Orbigny; *Anomalina* sp.; *Cibicides* sp.

The above mentioned foraminifera and the degree of their fossilisation suggest a Pleistocene to Sub-Recent age for the Miliolites.

84. A note on the direction of coiling in *Streblus beccarii* (Linn.).

V. V. SASTRI and S. C. PANT, Calcutta.

The authors have made certain observations on the coiling habits of the foraminifera *Streblus beccarii* (Lin.) occurring in (a) the Miliolite rocks of Porbandar area, (b) Recent beach sands of the Arabian sea near Porbandar, Saurashtra, (c) beach sands of the Indian Ocean near the Peninsular coast of Tinnevely district, Madras. This investigation was carried out in the light of the results published by Hans Bolli (1950), David B. Ericson, Goesta Wollin and Janet Wollin (1955, 1956) and Y. Nagappa (1957). It is observed that this species from the Saurashtra and Tinnevely beach sands exhibits both dextral and sinistral types of coiling and the individuals of both the types are in equal numbers; whereas the majority (up to about 80%) of the individuals from the Miliolites are sinistrally coiled. Similar morphological feature such as the coiling habit of foraminifera from Indian geological formations could be made use of in stratigraphical correlations.

85. Operculina-rich sands from the Sub-Recent deposits of Saurashtra and Madras coasts.

V. V. SASTRI and S. C. PANT, Calcutta.

During the geological survey of coastal deposits in Saurashtra and Madras the writers have come across extensive *Operculina* rich sands near Dwarka ($22^{\circ} 14'$:

68° 58') and a bed of sandy clay rich in Operculines about 10 feet below the ground level near Chettikulam (80° 09' : 77° 37'), Tinnevely District, Madras, in a well section, ½ mile east of the village and north of 47. Trigonometrical station. The old sand dunes, ½ mile inland from the present day sea beach and about 1½ miles S.E. of Dwarka that are being quarried for cement manufacture, have revealed the following foraminiferal assemblage, out of which operculines occur as flood :—

Operculina bartschi, Cush.; *Operculinella venosa*, (Ficht. and Moll); *Amphistegina lessonii*, d'Orb.; *Streblus beccarii*, (Linn.); *Cibicides* sp., *Elphidium crispum*, (Linn.); *Quinqueloculina seminulum*, (Linn.); *Gypsina* sp.; *Poreponides* cf. *lateralis*, (Terq.); and a doubtful genus belonging to the Peneroplidae.

The sandy clay from the well section near Chettikulam was found to contain :—

Operculina bartschi, Cush.; *Operculinella* cf. *venosa* (Ficht. and Moll); *Amphistegina lessonii*, d'Orb.; *Nonion scapha*, Ficht. and Moll; *Lagena marginata*, (Mont.); *Eponides* sp.; *Asterigerina* sp.; *Cibicides* sp.; *Globigerina bulloides*, d'Orb.; *Rotalia calcar*, d'Orb.; *Lenticulina* sp.; *Cancris* sp.; *Anomalina* sp.; *Gyroidina* cf. *soldani*, d'Orb.; ?*Pulvinulina oblonga*, (Williamson).

The foraminifera are mentioned according to their relative frequency of occurrence. The writers stress on the Operculina-rich microforaminiferal assemblages in these two widely separated areas. The profuse occurrence of Operculines in these two regions during the sub-Recent times is of interest in their distribution along the Indian coast.

86. Foraminifera from the Uttattur stage of the Cretaceous formations of Trichinopoly District, Madras.

M. V. A. SASTRY and V. V. SASTRI, Calcutta.

During 1956 the authors in the company of Dr. M. F. Glaessner, Reader in Geology and Palaeontology, Adelaide University, South Australia, collected several samples for foraminiferal examination from the Cretaceous beds of Trichinopoly District, Madras of which 16 samples are from the Uttattur stage. These could be grouped thus : one set of samples comes from the western border of the Uttattur stage near Karai (11° 8' : 78° 53'), another set from the south-eastern end of the Cretaceous formation north of Dalmiapuram (10° 58' 30" : 78° 57') overlying the coralline limestone and the third from west of Kulakkalnattam (11° 7' : 78° 57') and Kunnam (11° 14' : 79° 1'). Those from near Karai and Dalmiapuram have yielded similar foraminiferal assemblages as mentioned below while the third group of samples are devoid of foraminifera. The following genera and species constitute the foraminiferal assemblage :—

Ammodiscus uttatturensis, sp. nov.; *Haplophragmoides indicus*, sp. nov.; ? *Tritaxia* sp.; *Robulus macrodiscus*, (Reuss), *Lenticulina* cf. *rotulata*, Lamarck; *Lenticulina* sp.; *Marginulina* cf. *jarvisi*, Cushman; *Dentalina gracilis*, d'Orb.; *Dentalina* sp.; *Pseudoglandulina manifesta* (Reuss); *Pseudoglandulina* sp.-1; *Saracenaria navicula* (d'Orb); *Palmula suturalis* (Cushman); *Fronicularia* sp.-1; *Lagena* spp.; *Guttulina* sp.-1; *Pyrulina* sp.-1; *Bolivina* sp.; *Virgulina* sp.; *Uvigerina* sp.; *Vaginulina kochi*, Roemer; *Valvulineria* sp.; *Gyroidina* sp.; *Anomalina tenesseensis*, W. Berry, *Anomalina indica* sp. nov., *Cibicides* sp., *Discorbis* sp., *Pleurostomella* sp.-1, *Globigerina bulloides*, d'Orb., *Globigerina planispira*, Tappan.

The samples from the western border represent the basal Uttatturs as they rest directly on the Archaeans or the Gondwanas. It is seen from the above assemblages that the samples from the western border of the Uttatturs and those from the south-eastern end of the formation have yielded similar foraminifera. This assemblage is characterised by the occurrence of *Globigerina planispira* in large numbers in asso-

ciation with other common forms which could be taken as characteristic of the basal Uttatturs, according to our observations in the field.

The present investigation suggests that the rocks near Dalmiapuram were deposited under similar environmental conditions as that of basal Uttatturs and could be contemporaneous in age with the latter.

The microfauna of the basal Uttatturs is suggestive of an Upper Albian age.

87. A preliminary note on fossil Shark Teeth from Baripada beds, Orissa.

B. S. TEWARI and (Km.) NIRJA AWASTHI, Lucknow.

A fairly large collection of Shark teeth, tailspines and fragments of bones have been examined and studied from the grey shales and marls of Baripada beds considered to be of Lower Miocene age.

Several teeth of *Carchariolamna heroni* Hora, *Hypoprion horai* Tewari, *Prionodon gangeticus* Noetling and two new species, *Aprionodon horai* n.sp. and *Aprionodon misrai* n.sp. have been sketched and described in detail. In addition to the above, the Baripada beds have yielded species of *Bolivina*, *Bulminella*, *Cibicides*, *Elphidium*, *Globigerina*, *Nonion*, *Uvigerina* and several species of *Rotalia*.

The present collection appears to be in a state of much better preservation as compared to the material described by late Dr. S. L. Hora.

Thin sections, both longitudinal as well as transverse, have been very useful in the present study.

In the Baripada beds, the occurrence of *Prionodon gangeticus* and *Myliobatid* tailspines, similar to those found in Yenangyoungian (Lower Miocene) of Burma, favours the view of their being of Miocene age instead of Eocene.

88. On the occurrence of Kirthar in Jaisalmer, Rajasthan.

A. K. CHATTERJI, Calcutta.

The nummulitic limestone of Kirthar age is an important landmark in the world stratigraphy. S. N. Singh (1951, 1952) reported the occurrence of Kirthar from Kolayet near Bikaner in Rajasthan, and drew a good picture of the Kirthar coast line in India. The present note reports the occurrence of Kirthar in Jaisalmer, and thus extends the Kirthar coast line further south from Bikaner to Jaisalmer.

Two distinct Eocene horizons are present in Jaisalmer, one containing *Nummulites ataticus* Leymerie and *Assilina granulosa* d'Archiac of Laki age and the second an upper one containing *Dictyoconoides cooki* (Carter), and *Alveolina oblonga* d'Orbigny along with *N. ataticus* and *A. granulosa* indicating a lower Kirthar age.

89. Some Aspects of Brachiopod Growth.

KARUN C. MITRA, Jadavpur.

Ontogeny of shell profile of brachiopods have been studied with the help of longitudinal section along the plane of symmetry of shell. Parameters chosen for the investigations are length, thickness and angle θ formed by tangent with the line representing the length. In most cases length and thickness demonstrates an allometric relation while the relation between length and angle θ can only be represented by a logistic curve. The profile of ellipsoidal shell such as terebratula describes a logarithmic spiral.

90. Fossil Plants from the Athgarh Stage, Cuttack District, Orissa.

P. G. ADYALKAR and C. NAGESWARA RAO, Calcutta.

A collection of duplicate plant fossils from Ghantikhal ($20^{\circ} 30' : 85^{\circ} 45'$), the type locality of Athgarh sandstones is described and the following forms are identified therein.

Filicales	:	<i>Cladophlebis indica</i> , <i>Rhizopteris</i> cf. <i>balli</i>
Pteridospermae	:	<i>Thinnfeldia</i> sp.
Cycadophyta	:	<i>Ptilophyllum</i> cf. <i>acutifolium</i> , <i>Taeniopteris</i> cf. <i>spatulata</i>
Coniferales	:	<i>Retinosporites</i> sp., <i>Araucarites</i> sp.
Ginkgoales	:	<i>Baiera</i> sp.

Of the above, *Ptilophyllum* cf. *acutifolium*, *Taeniopteris* cf. *spatulata*, *Araucarites* sp. and *Baiera* sp. are reported for the first time from that locality. The general assemblage of the flora confirms the earlier view that the Athgarh sandstones are correlated with the Rajmahal stage of the Upper Gondwanas.

91. Glossopteris from the Mahadevas of Hinjrida, Talchir Coalfield, Orissa.

K. S. SUBRAMANIAN and C. NAGESWARA RAO, Calcutta.

In this paper the authors have recorded *Glossopteris indica*, *G. communis*, *G. retifera*, *G. angustifolia* and scale leaves of *Glossopteris* from the Mahadevas of Hinjrida ($20^{\circ} 58' : 84^{\circ} 43'$) situated in the western part of the Talchir Coalfield. Considering the field and fossil evidences, it has been suggested that some of the rocks classified as the Mahadevas may be the equivalents of the Panchets.

92. Plant fossils from the Kota-Maleri Beds, Adilabad District, Andhra Pradesh.

C. NAGESWARA RAO and S. C. SHAH, Calcutta.

This note deals with the new plant fossils collected by the authors from the Kota-Maleri beds of Adilabad Dt., in course of mapping of the Upper Gondwanas of the Pranhita-Godavari Basin. The fossils include the following :—

Equisetales	<i>Schizoneura</i> sp., <i>Neocalamites</i> sp.
Filicales	<i>Cladophlebis</i> cf. <i>indica</i> , <i>C.</i> sp.
Pteridosperms	<i>Glossopteris indica</i> , <i>G. communis</i> , <i>G. stricta</i> , <i>G. ? ampla</i> , <i>G. ? retifera</i> , <i>G.</i> sp., scale leaves of <i>G.</i> , <i>Thinnfeldia hughesi</i> , <i>Dicroidium odontopteroides</i> .
Cordaitales	<i>Noeggerathiopsis</i> sp.
Cycadales	<i>Nilssonsonia</i> sp., <i>Zamites</i> sp., <i>Taeniopteris spatulata</i> .
Coniferales	<i>Pagiophyllum</i> sp.
Incertain sedis	<i>Podozamites</i> sp., cone stem and seed impressions.

On the basis of these fossils an age ranging from Upper Triassic to Rhaetic is advocated to the lower horizons of the Kota-Maleris, whereas the Upper horizons may range up to Jurassic. The detailed study of the faunal assemblage which is in progress might throw an additional light on their age,

93. A Note on the Fossil Flora of the Chikiala Beds, Pranhita-Godavari Valley.

C. NAGESWARA RAO and S. C. SHAH, Calcutta.

The Chikiala beds represent the youngest Gondwana formations of the Pranhita-Godavari basin of Bombay and Andhra Pradesh States. They overlie the Kota-Maleri beds conformably and comprise conglomerates and sandstones, with minor bands of shales and clays. Ferruginous concretions are frequent whereas the calcareous element is very little. These beds have been considered to be unfossiliferous.

During the course of their examination of these beds in parts of Adilabad and Chanda districts, the authors collected the following plant fossils from the sandstones and shales of the Chikiales :—

Filicales	<i>Cladophlebis indica</i> , <i>Hausmannia</i> cf. <i>buchii</i> and <i>H.</i> sp.
Pteridosperms	<i>Thinnfeldia odontopteroides</i> .
Cycads	<i>Pholophyllum acutifolium</i> , <i>Taeniopteris spatulata</i> , <i>Otozamites</i> sp. <i>Dictyozamites</i> sp. and <i>Nilssonina</i> sp.
Conifers	<i>Araucarites</i> sp.

Though W. King himself was doubtful about the Gondwana affinities of these beds, yet on lithological grounds he considered them to be equivalent to the Tirupati sandstones of the coastal Gondwanas and consequently, later workers correlated the Chikialas with the Jabalpurs. The above assemblage of flora points out that these beds are definitely of Upper Gondwana age and conforms the opinion, doubtfully held so far, that the Chikiala beds are most probably the equivalents of the Jabalpur beds.

94. Kutch Microfauna, Eocene Foraminifera.

B. S. TEWARI and O. N. BHARGAVA, Lucknow.

The present paper describes foraminifera from the Eocene rocks of Kutch, Western India. The material was collected from the compact limestone occurring about half a mile north of Waghopadar (23° 28' : 68° 47'), of Middle Kirthar (Lutetian) age.

Fauna includes species of the following genera mentioned in order of abundance :

1. *Quinqueloculina*
2. *Nonion*
3. *Nonionella*
4. *Textularia*
5. *Pyrgo*
6. *Rotalia*
7. *Globorotalia*

Besides the forms mentioned above, *Spiroloculina*, *Bifarina*, *Clavulinoides*, *Bulimina*, *Cibicidella* and *Linderina* are also met with frequently.

A few species each of *Linderina* and *Cibicidella* have been found in the material.

The assemblage shows affinity to the fauna of Middle East of the same age and is characterised by the abundance of *Nonion scapha* var. *indica* Jacob and Shastri.

Fauna is characteristic of warm estuarine condition.

95. Foraminiferal Genera and Species from Burdigalian Beds of Kutch.

B. S. TEWARI and T. N. SAHAI, Lucknow.

Little attention has so far been paid to the micro-foraminiferal studies of the Miocene beds of India. The present paper gives a systematic description of the foraminiferal fauna from the Miocene beds of Kutch. The material under investigation was collected from the dark yellow argillaceous limestones, exposed about half a mile northeast of the village Vinjhan ($23^{\circ} 6' 10''$: $69^{\circ} 4' 50''$), Kutch. These beds have been ascribed to the basal part of the Upper Gaj (Burdigalian) on the basis of the occurrence of *Miogypsina* (*Miolepidocyclina*) *droogeri*, *Miogypsina* (*Miogypsina*) *irregularis*, *Miogypsina* (*Miolepidocyclina*) cf. *burdigalensis*, *Taberina* (= *Orbiculina* = *Orbitolites*) *malabarica*, *Austrotrillina howchini*, *Archaias*, *Ostrea latimarginata*, *O. gajensis* and *Turritella* (*Torculoidella*) *angulata*.

The fauna consists of several species of the genera *Cibicides*, *Elphidium*, *Nonion*, *Strebilus*, *Textularia*, together with abundant members of the family Miliolidae. The occurrence of the species *Elphidium indicum*, *Asterigerina dollfussi* and the characteristic Indo-Pacific foraminifer *Textularia foliacea* is worthy of attention.

The fauna shows a close affinity with the micro-foraminiferal fauna of the Burdigalian beds of Surat and Broach area, Western India. Several identical species such as *Strebilus anectens*, *S. Papillosus*, *Asterigerina dollfussi* etc. have been reported.

The faunal assemblage provides evidence for the ecology of the beds, which are inferred to have been deposited under warm shallow water conditions.

95A. On Burdigalian Microfauna from Waghot, South-western Kutch.

B. S. TEWARI and K. K. TANDON, Lucknow

The present paper deals with the assemblage of microfossils found in the beds of Burdigalian age of Kutch. The material comes from a place half a mile south of Waghot ($23^{\circ} 24'$: $68^{\circ} 44'$). The rocks consist of cream coloured compact foraminiferal limestone underlain by a band of shales containing white casts of *Turritella* belonging to the Upper Gaj beds (Burdigalian).

The fauna consists of *Breynia carinata*, *Ostrea latimarginata*, *Turritella* (*Torculoidella*) *angulata*, *Miogypsina* (*Miogypsina*) *irregularis*, *Miogypsina* (*Lepidosemicyclina*) *droogeri*, *Taberina* (= *Orbiculina* = *Orbitolites*) *malabarica*, *Austrotrillina howchini*, *Clavulina*, *Elphidium indicum*, *Textularia*, *Lepidocyclina* (*Nephrolepidina*) *sumatrensis*, *Lepidocyclina* (*Nephrolepidina*) *Borneensis*, *Rectobolivina*, *Eponides*, *Noion*, *Asterigerina*, *Cibicides*, *Planorbulina*, *Opcerculina*, *Strebilus*, *Lagena*, *Pyrgo*, *Triloculina*, *Quinqueloculina* and other Miliolines. Ostrocode genera such as *Bairdopilata rajnathi*, *Paracypris*, *gajensis*, *Haplocytheridea saurashtrensis*, *Trachyleberis bhujensis*, *Jugosocythereis*, *Cytherelloidea kathiawarensis*, *Cytherelloidea barkhenensis*, *Cytherella cheropadiensis* and *Krithe indica* var. *kutchensis* are also commonly found.

Besides these other microfossils like Ophuroid ossicles, fish bones, tailspines, tooth and tetrad sponge spicules have also been sporadically met with.

The above fauna indicates that the beds were deposited under warm shallow water condition.

96. On Microfauna and age of Jaffna Limestone, Ceylon.

B. S. TEWARI and K. K. TANDON, Lucknow.

The paper records the occurrence of the index fossils *Austrotrillina howchini*, *Taberina* (= *Orbiculina* = *Orbitolites*) *malabarica*, *Borelis melo*, *Gypsina globulus*,



Nephrolepidina sumatrensis, *Amphistegina*, *Rotalia*, *Carpentaria*, *Textularia*, *Eponides*, a single section of *Flosculinella*?, *Quinqueloculina*, *Triloculina* and other Miliolines along with Calcareous Algae such as *Lithothamnium* and *Lithophyllum* together with Cheilostome Bryozoa from the hard, cream-coloured, indistinctly bedded Jaffna Limestone which is somewhat crystalline, from Nirukiri, Jaffna, Northern Ceylon. The enclosed fossil Foraminifera and Algae have been illustrated and described.

Spiroclypeus orbiloides (Carter) has not been met with as reported by Douville' from Jaffna Limestone. It seems, however, that *Amphistegina* has been erroneously referred as *Spiroclypeus* by Douville'.

The present assemblage throws light on the ecology of beds which were deposited as reefs under warm shallow-water conditions. The foraminifera assemblage fixes the age of Jaffna Beds to the upper part of the Lower Miocene (Burdigalian) and most certainly contradicts the Vindobonian and still younger ages suggested by Wayland and Davies; Douville'; Furoin and Lemoine.

These beds have been correlated with the Upper Gaj beds of Sind; Kutch and Kathiawar; and Quilon Limestone of Travancore. The foraminiferal fauna bears close relationship to the Burdigalian fauna described from Western India.

GROUNDWATER

97. Water Table fluctuations in Meerut District, Uttar Pradesh.

R. N. MATHUR, Varanasi.

The paper records the results of the investigation carried out in Meerut district for studying the fluctuations of the water table due to variations in rainfall amounts. The district of Meerut ($28^{\circ} 35'N-29^{\circ} 15'N : 77^{\circ} 10'E-78^{\circ} 5'E$) is a doab district situated in the west Upper Ganga Plain and covers an area of 2,300 square miles.

It has been found that the water table fluctuations over Meerut district are occurring mainly under the influence of variations in rainfall and tube-well pumping. On account of their high degree of correlation with rainfall the water table fluctuations are distinctly seasonal in character. In general, a water table rise is noticed from July to September and a water table decline from October to June. Apart from certain minor causes, the magnitude of the water table fluctuations have been found to vary over the District according as the area under consideration is a canal-irrigated or a tube-well irrigated area.

A linear relationship between rainfall and the corresponding water table rise has been derived and it may be expressed by the equation :

$$r = 1.164 R - 5.238$$

where R is the rainfall and r the corresponding water table rise (both in inches).

The water table fluctuations due to rainfall in the Daha area, where the tube-well pumping rates are the highest in the District, have been found to be somewhat different from the rest. Thus, in this area, the annual water table rises, even during a heavy rainfall year, are quite insignificant.

Geophysics

98. Further Studies on the Diurnal Variation of Heat flux into the Soil at Waltair.

B. PADMANABHAMURTY and V. P. SUBRAHMANYAM, Waltair.

Soil temperatures at the Andhra University Meteorological Observatory were measured every hour on representative days in the months of January, February,

April, May and August. The hourly heat flux, q , at the soil-atmosphere interface was evaluated from the equation

$$q = -k \rho c \left(\frac{\sigma \tau}{\sigma_2} \right)_{z=0}$$

where k is the thermal diffusivity, ρc is the heat capacity of the soil and $\left(\frac{\sigma \tau}{\sigma_2} \right)_{z=0}$ is the depth variation of temperature in the soil. Simultaneously heat flow into the soil on two occasions was also measured with the aid of a Beckman & Whitley heat-flow transducer installed at a depth of 2.5 cms. below the ground.

Curves representing the diurnal variation of heat flow into the soil were presented. These curves clearly show that greater amount of heat is stored in April when there is stronger insolation than in the months of January or February when the incoming radiation is comparatively weak due to lower elevations of the sun. The overall inflow in the month of May is slightly reduced owing to smaller temperature gradients between the ground and lower layers whereas in August the inflow as well as outflow both decrease because of increased cloudiness. Further, the curves indicate an unmistakable seasonal march of the evening minimum from around 1700 hrs. in January to about 1900 hrs. in May and again a reversion to 1700 hrs. in August with the establishment of the southwest monsoon. The maxima of positive flux at 1100 hrs. are consistent and are in conformity with the values of Schreiber and Lettau.

Heat flow as obtained from the temperature distribution was graphically compared with the values of the transducer; not only are the latter less in magnitude but the curves also indicate a lag in the times of occurrence of the maxima of influx and efflux in the case of the transducer. This is as it should be, since the transducer is at a depth of 2.5 cms. below the ground while the computed data represent heat flux into the soil at the surface.

Geomorphology

99. The Geographer and the Geophysical Year.

MOHD. YUNUS, Naini Tal.

The "International Geophysical Year" (IGY) began on the 1st July, 1957. It continued for 18 months. The investigations demanded extension of the period and, therefore, all the activities continued till the end of 1958 as the "International Geophysical Cooperation, 1959".

The programme of the IGY was ambitious and varied. It covered a variety of realms and regions. The scientific topics for study were Meteorology and Upper atmospheric exploration, Solar Activity, Ionospheric studies, Geo-magnetism, Aurora, Cosmic Rays, Latitude and Longitude determination, Oceanography Glaciology, opening of the Antarctica, Seismology, Gravity measurements, Space studies and Satellite programme.

The paper provides details of investigations and researches carried on in the above fields of knowledge. To a geographer most of these will provide a mine of information. They will cover and influence numerous other branches of knowledge which are of fundamental importance to geographical studies.

The conclusions derived from explorations and discoveries will completely revolutionize and reorient the thought and concept of a geographer regarding the Universe and the Earth and the forces acting upon it from within and outside. The geographer should be prepared to follow and digest the new investigations and to correlate and interpret them for the welfare and advancement of mankind in different fields of their application.

100. The Drainage Patterns of the Sagar-Damoh Plateau.

B. G. TAMASKAR, Amravati.

The varied and diversified terrain and structural features of the Plateau exhibit a remarkable and spectacular diversity and characteristics of drainage. More than 90 p.c. of the total drainage area belongs to the Ganga system, except the eastern and southern peripheral zones which are shared by the Narbada System. The major part of the drainage is carried off to the Jamuna via the Betwa and the Ken, on the east.

The primary water-divide coincides approximately with the Vindhyan Hills, to the south.

Despite the seasonal character of rainfall, the principal rivers, though rainfed, are surprisingly perennial.

The development of the following regional or local patterns may be recognised :

1. The annular and radial pattern on an extensive scale on the Basahari Plateau, in the N.W. of the Sagar-Damoh Plateau.
2. The radial pattern, prominently developed on the Kalumar hill.
3. The radial pattern on isolated residual hills in the intervening river-basins.
4. The braided drainage pattern close to Hindona.
5. The trellis pattern in the lower reaches of the Bewas.
6. The transformation of the original rectangular arrangement of drainage pattern into dendritic one.
7. The annular drainage pattern of the tabera Basin.

101. Physiographic Regions of the Central Machkund Basin and the Eastern Ghats in South Jeypore (A Geomorphological Study).

AMAL KUMAR SEN, Calcutta.

The paper records some micro-geomorphic details in the physiographic regions of the Central Machkund basin and the Western margin of the Eastern Ghats in south Jeypore. The area has been divided into five physiographic regions.

Dharamgod-pandraguda country :—The geomorphic characters of the rivers and land forms have been discussed.

Kondakambaru-Dongar country forms the Western margin of the Eastern Ghats. The irregular topography in the west, the waterfalls, unusual bends of the rivers have been discussed in relation to structure.

The Western plateau has been discussed in relation to the erosional remnants and other-geomorphic characteristics.

The Pachipenta country that forms the hilly Eastern Ghats has been dealt in relation to its structure. The existence of a lateritic plateau which is the remnant of a much larger plateau, above 3500' contour has been identified and the present topography has been explained due to a subsequent uplift.

The Araku region has been identified as a peneplane and its relation with the peneplanes of the Western plateau is treated with.

The paper concludes with a few points for further investigation on the development of the unusual bends of the rivers.

102. Drainage Pattern in Akola District, Berar.

N. G. JAIN, Amravati.

1. Area under discussion lies in the heart of Berar and extends between $19^{\circ} 51'N$ - $21^{\circ} 16'N$ latitude and $76^{\circ} 38'E$ and $77^{\circ} 44'E$, longitude.

2. The area forms a plain region traversed by a strip of Satpura hills. Northern half is a part of a great Payanghat plain and the southern one forms a part of Ajantha hills. It is covered with Deccan Trap, occasionally coated with newer alluvium. The area has a peculiar drainage pattern, characteristic to Deccan Trap.

3. The main watershed, is neither sharply defined nor prominently marked. It extends along the top of the table land following a line firstly from east south-west to south and then towards north-west.

The country north of this line is drained by perennial R. Purna and its tributaries. This forms a catchment area of R. Tapti. R. Penganga with its tributaries drains southern country and forms a part of a catchment area of R. Godavari.

4. *Special features :*

A. Diversion of R. Shahanur : R. Shahanur the tributary stream of R. Purna previously was flowing due east and was pouring its water into R. Purna at North-west of 77° E. longitude. Later on, during the famine of 1896-97, its channel was diverted at Dahianda and formed an absolute gorge 60 feet deep.

B. Westward bend of tributary streams of R. Purna. This indicates the dip due west.

C. Development of Marshy-lands : Rivers being reaching to maturity, are occasionally changing their courses. Such changes are noted in R. Purna near Borgaon and with R. Man near Nimba. The area thus left has been reclaimed and put to cultivation.

103-4. Moradabad District : A Study in Physiography.

S. L. DUGGAL, Muzaffarnagar.

The district of Moradabad comprises about 2,293 square miles in the west-central part of the Rohilkhand, which region it represents in both its physical and human aspects. Lying between the Himalayan foot-hills and the Ganga river it benefits by the drainage of the Ramganga, a left bank tributary of that river.

Geologically speaking, it is merely an alluvial expanse with a thin cover of aeolian deposits here and there. The sediments are generally divided into two horizons, namely the older Alluvium or Bhangar comprising the ground above the present flood level and the newer Alluvium or Khadar confined to the river channels of today. The aeolian deposits or the Bhurridges of sandy soils have been laid where there were obstacles to wind movement such as clumps of trees or shrubs along the upper courses of the streams. They form the main water-partings between the various streams of the district.

The district has the general appearance of an open plain and on an average the land lies at about 670 feet above the mean sea level, but it has a marked slope from north to south where the average fall amounts to 3 feet per mile. The surface, however, is broken considerably by sand dunes, river valleys and a few shallow depressions and on this account the country-side presents a very remarkable diversity of physical features.

Physiographically, we can easily divide the district into four main units and a number of subdivisions, each of which has some significant characteristics, which have far reaching influences on the development of the district.

In fact, the area affords a very useful study in how many physiographic details are to be seen in the plains of northern India and shows that the terms Bhangar and Khadar have very wide implications in actual nature.

105. The Geomorphic features of Midnapur Coast.

SATYAKAM SEN, Chandernagore.

The purpose of the paper is to trace out the salient features of coastal sand-dunes and discuss the important factors of the landscape. Geomorphic study of the Midnapur Coast reveals interesting features of physiographic form. The drainage of this area under investigation has got its own distinctive pattern. The drainage channels are tidal. The stages of the formation of the oxbow-lakes have been traced out. The magnitude and the thickness of the sand-deposit, sand hills and sand-ridges varies from place to place. The size and shape, the nature of formation of the sand-dunes have been discussed in detail in this paper. The author finally traces out the influence of geomorphic features on settlement pattern.

106. Hydrographic features of the Adi Ganga Bhumi.

S. P. CHATTERJEE and KANANGOPAL BAGCHI, Calcutta.

The Southwestern corner of the Ganges delta stretching from Calcutta southwards and enclosed between the Hooghly on the West and the Bidyadhari-Malta on the East, North of the embankment of 24-Parganas has been named as the Adi-Ganga Bhumi.

The Adi-Ganga, a former channel of the Bhagirathi had at one time flourished over this region and was responsible for land building activities. It is now defunct but Hydrographic and Geomorphic features testify to its existence. The Bidyadhari and Piyali are now in comparatively better condition but they are also approaching decay. The whole area has been shut off by the 24-Parganas embankment and it has modified very greatly initial drainage pattern. Details relating to the above aspects have been discussed in the paper. It has also been illustrated.

Climatology**107. Arid conditions in the Central Deccan—a climatic study.**

B. SUBBA RAO and V. P. SUBRAHMANYAM, Waltair.

Identification of arid and semi-arid regions on a climatic basis is the first essential step in any project of reclamation for agricultural or other purposes. In the delineation of such climatic types, schemes of de Martonne, Köppen and Thornthwaite have been widely used and in particular Thornthwaite's method of 1948 found much support for the climatological study of arid zones. His modified scheme of 1955 placed a very powerful tool in the hands of the climatologist and the present paper is an attempt at understanding the arid conditions of the Central Deccan according to this scheme.

Available data of temperature and precipitation for a large number of stations was used for this study and the water needs of stations for which precipitation figures alone were available were determined by careful interpolation techniques proposed by Carter. Analysis showed clearly the existence of arid conditions in this portion of the peninsula and this feature is well-supported by the ecological and edaphic studies on the distribution of natural vegetation and soil groups.

Investigation according to de Martonne's scheme too confirmed the conclusions from the above analysis and the interesting coincidence between the climatic indices of de Martonne and Thornthwaite for the arid zone of the Deccan seems to lend strong support to Bhatia's results of study in Rajasthan region.

B. GEOGRAPHY**Economic Geography****108. Livestock and their problems in Orissa.**

B. N. SINHA and G. K. MAZUMDAR, Calcutta.

The livestock not only thrives on the products of the land but also enriches it by supplying manure in a primarily and predominantly agricultural State like Orissa with 79.3% of her population depending on agrarian economy are of importance. With non-perennial streams and high surface run-off of a predominantly Gondwana topography, pisciculture is absent and the bulk of the protein is provided to 14.6 million people by 11.1 million livestock population of Orissa.

While India with 34% of cattle and buffaloes leads the World, Orissa with 4.9% of the area possesses 4.8% of Indian total bovine population and thus falls short of the Indian density. The Coastal and Sambalpur districts have a higher concentration of bovine population since they are more used as draught animals. The density of cattle per square mile of area is the maximum in Cuttack followed by Balasore, Bolangir and Puri Districts. By application of Kendall's "Ranking Co-efficient" method for cattle density per square mile, per thousand people and density per acre of grazing land, Sundargarh stands first while all the coastal districts are less efficient.

In the value of milk production although India ranks next to U.S.A, the yield per head of Indian cattle is appallingly low and Orissa's figure is even lower than that of the Indian average. The quality of the Indian cattle as well as the per capita consumption of milk is lowest among the advanced countries of the World and Orissa ranks last among the leading Indian States. While the daily per capita intake of milk and its products is only 0.1 ounce per day with agricultural labourer in India, Orissa has a lower figures against a standard of 10 ounces because of low income.

By field investigation it has been estimated that two acres of grassland are required per unit of livestock in Orissa and by 1951 her requirement for 8.8 million units was 17.63 million acres. These figures may be placed at 20 million acres for about 10 million cattle by 1960. Judged by optimum capacity of land even though Orissa maintained a surplus bovine population of 3.2 million in 1951 she faced a deficit of 0.38 million of draught animals for her 1.96 million ploughs against the available strength of 3.92 million. In the face of a daily shortage of 44,000 tons of fodder planning must be aimed at reducing the unwanted number of cows, she-buffaloes and bovine population of less than three years of age and increasing the number of bullocks and male buffaloes for better agronomy to prevent the bovine population from starving from birth to death. Efficient management by adopting the "rotational method", changing the practice of grass cutting to hay making, better controlled breeding for specific purposes, introducing artificial insemination, campaigning for castration of inferior bulls, extending the veterinary facilities to rural areas, providing better marketing facilities of milk and dairy products, standardising the products and controlling the prices on regional basis, are some of the few suggestions offered.

109. Dehradun Valley through the Ages.

RAMESH DUTTA DIKSHIT, Allahabad.

Resting upon the conviction that 'the Geographer must look back as well as forward if he is to study fully the interaction between Place and Man . . . for when

rightly understood there is something peculiarly fascinating in tracing the past in the present, in viewing Place as very largely determined by what has happened before' and also that the human phenomena must be studied as one studies the moving bodies—by determining the place and time at which they begin and then indicating the direction of their movement, an attempt has been made in this paper to study the different phases through which the Dehra Dun valley has passed from the prehistoric ages to the present day.

Six phases in the historico-economic development of the valley have been recognised. An attempt is made to establish that contrary to the opinion of a casual observer, who, seeing the sparse population of the valley, may hold that it came to be settled late in history, the valley of Dehra Dun actually became the home of man as early as few parts of India. Causes for its changing fortunes through the ages have been traced. The historical events have been reviewed in a Geographical perspective and Geographical explanations of some baffling historical problems have been attempted.

110. Location of the Chemical Industry of Baroda.

BHARAT L. BHATT, Rajkot.

An attempt has been made in this paper to study and analyse the factors that have led to the concentration of the Chemical Industry in Baroda. A detailed study of the history of the Industry and the part played by the policies of the local Government on the present set-up is also undertaken.

111. A quantitative method for the measurement of crop diversification in India.

SHYAM S. BHATIA, Delhi.

To measure crop diversification quantitatively, an index of crop diversification is calculated. The index equals percent of net area sown under X crops divided by the number of X crops, where X represents crops that individually occupy ten per cent or more of net area sown in an aerial unit. The higher the value of the index, the lower the degree of crop diversification and vice versa. However, the value of the index cannot be less than ten. The closer the index value is to ten, the higher the degree of crop diversification for the unit under consideration.

The index values for all districts of India (for which agricultural statistics are available) are arrayed and quartiles determined. The districts are then grouped into four categories showing the degrees of crop diversification, *viz.* very high, high, little and very little diversification. It may be pointed out that the index values should be considered in the form of continuum in which areas at the two extremes are somewhat clearly differentiated while those between the two extremes are transitional in nature.

112. A Geographical Study of the Lac and Shellac Industries of Bihar.

S. A. MAJID, Patna.

The paper is an attempt to study some of the main aspects of the lac and shellac industries of Bihar. It begins with a history of the growth of the export trade of lac and its various products from India because the country depends almost entirely on the foreign market for their disposal. The various forms of lac exported and their main destination have also been dealt with. The position of Bihar in

the field of lac production has then been ascertained. This is followed by detailed considerations of lac 'hosts' and crops, processes and distribution of lac cultivation and the factors controlling the production and distribution of lac. Then comes the study of the methods and localization of shellac manufactures in Bihar. The paper concludes with observations regarding the impending crisis the lac and shellac industries are faced with and general suggestions for improving this situation.

113. Power Resources of West Bengal and their Utilisation.

MANORANJAN CHAUDHURI, Calcutta.

West Bengal as the most industrialised state in India is the greatest consumer of various fuels in the country. The state has embarked upon a policy of expanding her industrial activities further. Time has therefore dawned to examine critically the directions in which the power resources of the State can be better harnessed and utilised for effective development of her industries. The present paper attempts to analyse the distribution and utilisation of the mineral fuels in the state of West Bengal and suggests plans for their future development.

114. Raw Material as a factor in the localization of the Indian Iron and Steel Industry.

P. DAYAL, Patna.

While the steel industry in Western Europe and the U.S.A. is essentially market-oriented, the raw material would appear to be the basic attracting force in India. Market has no doubt exercised a certain modifying influence in the location of the Indian centres, but nowhere has its pull been so strong as to take the industry away from the geographical limits set by the raw material. In the selection of specific sites the influence of the availability of perennial and abundant water supply has been decisive.

The influence of the raw material may be discerned even in the early years of the industry. The first attempts (1830-67) failed because of the poor quality of the ore used and the difficulties of maintaining sustained supplies of charcoal. The partial success of the industry between 1875-1907 was due to the availability of coking coal in the vicinity of Kulti, though the iron ore continued to be poor in quality. The final success that came in 1908 (Jamshedpur) was made possible by the assured supply of good coking coal from Jharia and rich iron ore from Mayurbhanj.

The attachment of the industry to raw materials may be explained by the concentration of resources and the diffused character of the Indian market. Under such conditions, the raw material attraction is even stronger, particularly when the finished product weighs very much less than the raw material.

Another feature of the Indian centres is their location nearer iron ore than coal. This is chiefly due to (a) the concentration of coking coal in a small area thereby restricting and weakening its locational pull, and labour shortages and lack of adequate water supply in the coalfields, (b) the relatively wide distribution of the iron ore coupled with the occurrence of other raw materials near the ore. The State too has encouraged this pattern of development by emphasizing regionalisation of the industry. In the near future the industry is likely to show the same trend of localization near raw materials, but a possible development is the growth of the industry on the coal site, because of the great economy in the transportation of raw materials by offering double traffic to the railways between Durg and Sundargarh ore and Damodar coal.

115. Geographical background of Bhilai Iron and Steel Plant.

MOHD. NASEER KHAN, Allahabad.

Out of the three steel plants which the Government of India has launched in the Second Five Year Plan to meet the scarcity of steel products in the country, the Bhilai Iron and Steel plant is geographically the most significant. It is very ambitious in its outlook and views at producing one million tons of finished steel a year.

In the paper a geographical analysis of the plant is attempted; its site and situation in respect to raw materials, market, capital and labour are assessed to evaluate its contribution to the economy of the country with its extensive level land and hard soil. The Bhilai area is excellently situated for the location of steel plant for the load capacity of the soil is 3 to 4 kilograms per sq. cm. which can easily bear the weight of heavy plant. From the suitably located iron ore deposits of Dhalli-Raghra hills, with its iron contents of 65½, cheap mining and easy transportation is assured. The reserve is rich enough to meet the demand of the plant. Limestone of good quality is abundant and manganese is to be produced from the Balaghat and Bhandara mines which are connected by rail to Bhilai. Dolomite, too, is not far to seek. Difficulties of water supply have been suitably met. The greatest drawback with the plant is of fuel supply. The rich fields of Jharia and Bokaro are far away and the coal found nearer the plant is unsuitable for coking purposes. However, arrangements have been made to run the plant on combined supply of coal from Jharia, Bokaro and Koraba fields.

The benefit of good transportation and cheap and abundant labour enjoyed by the plant location is fully explained and the problem of electric supply is amply dealt with and the suitability of the plant with respect to market explained. In the end the impact of the plant on the local population and the future economy of India has been studied.

Human Geography**116. Anatomy of the Tarai Village.**

DR. L. R. SINGH, Allahabad.

In this paper the author has attempted a study of anatomy of four Tarai villages whose cultural configuration bears the distinctive marks of its regional geographic personality. He has discussed the regional village plans which show how cultural forces acting within the physical framework have presented varied and varying arrangements of houses and streets. Some of the distinguishable plans as discussed in the paper are : Linear, Rectangular, Circular or Oval and Amorphous.

117. Natural Vegetation and Man in the Tarai Region of U.P.

L. R. SINGH, Allahabad.

Considering its ecological conditions, Tarai appears but a region of marsh and fen, a land of sluggish streams and water-choked morasses, the soil being moist alluvium which encourages but the growth of coarse grasses and thickets. At its best the natural vegetation is of a savana type, the vast continuous expanses like those at the foot-hills in the north, being less conspicuous. Because of defective hydrology the forests are stunted in their growth.

The *Sal* (*Shorea robusta*) is the most valuable denizen of the Tarai; among the miscellaneous, forming open, irregular and mixed forest, the semal (*Bombax malabaricum*), the haldu (*Adina Cordifolia*), the asna (*Terminalia tomentosa*), the tendu (*Diospyros melonoxylon*) and asid (*Lagerstroemia parvi flora*), the shisham (*Dalbergia sissoo*) and the khair (*Acacia catechu*) are important. Besides, the Tarai forests abound in bamboos, reeds, *baib*, *munj* and *ulla* grasses. That is why many forest industries are carried there.

But, because of colonization schemes most of the forests have been cleared, consequently the ecological balance of the region has been disturbed, resulting in manifold disadvantages to man. Hence it is the urgent need that the ecological balance should be restored by the application of the principles of synecology.

118. Occupational Structure in the Himalayan Beas Basin.

S. L. KAYASTHA, Varanasi.

In the Himalayan Beas Basin, agriculture is the main source of livelihood employing 89% of the total population. There is general absence of secondary resources of gainful employment. Since the pressure of agricultural population on cultivated land stands as high as 1121.4 persons per sq. mile, resources of land do not provide more than a bare sustenance. The size of holdings is uneconomic and shatters the basis of profitable agriculture. There is not much scope for extending the cultivated area. The agriculturist has often to turn to other works for supplementing his income. The high upland areas where agriculture is not quite repaying and where pastures and forests abound, have become the home of semi-pastoralists living by the wealth of sheep and goats. The southern unirrigated tracts of poor soils have become fertile grounds for recruitment to military services. Habitat bears in this area fairly direct relation to the occupations of people.

Kangra is more accessible than other tracts and is the most urbanized part. Here industry, commerce, transport and other occupations have comparatively greater importance. Commerce in the Himalayan Beas Basin is on a small scale and employs only 2% of the people. Transport and communications are highly restricted and are the weakest in the employment group (only 0.5%). Other services and miscellaneous sources provide employment for another 5% of the population. There is indication that with the development of transport, tourism, mining and industries for which scope exists, there will be steady reduction in the dependence on agriculture. However, there is no likelihood of rapid and large scale changes in near future.

119. The Concept of 'Geography of Communication'.

(Miss) M. VATAL, Allahabad.

In the modern world, the growing importance of the means of communication—the outcome of the satisfaction of man's desires namely economic, social, religious and political—which provides the needed links that bind all human activities to one another, now demands its fullest understanding and description.

The advanced Geographic thoughts and studies in Human and Cultural fields have resulted in the genesis of 'the Concept of Geography of Communication' or 'Verkehrs Geographic'. Its original study was either a mere enumeration of the surface facts or a deterministic approach in the interpretation of the inter-relationship between the man's environment and the selection of the means of transportation. But lately, Human Geographers could give it a new outlook by emphasizing

man and his 'Unproductive Occupation of the soil' in a natural frame work, on a regional basis.

The Geography of Communication with all its analytical and systematic approaches, aims at the analysis of the historical development of the means of transport; the physical or the natural factors to which it has adjusted or which are adapted due to new scientific inventions; the economic activities of agriculture, trade, industry etc. . . which call forth different transport net; the detailed traffic survey & the limits of their extension; the anatomy and physiology of the system of transportation and the extent of the competition among various means of transport and its geographical solution. The Geography of Communication or Circulation, stress the activity of man as the core of geographic study—justifying the cultural landscape of communication not merely as a concrete expression of human activity but side by side a representation of the relationship between the activity and geonomic setting of a region.

120. A Geographical Study of Transport and Communications in the Himalayan Beas Basin.

S. L. KAYASTHIA, Varanasi.

The availability of transport and communicational facilities is essential for the economic and social development of any area. Transport facilities are not extensive in the Himalayan Beas Basin. Nonetheless, travel and transport have been recorded since early times. But the present state of facilities—just a single straggling railway line and two arterial axial roads convey the impression that a new area is being opened up. Here, it is just a case of under-development. The omnipresence of steep inclines and innumerable streams presents problems of great magnitude. Heavy rainfall and snow in the higher parts add their quota of difficulties. Construction and maintenance costs are very high. Steep inclines, streams, snow, floods, erosion and landslips hamper circulation. Therefore, the boon of modern means of transport is confined to mostly valley areas.

Human and animal transport will continue to play a very important part in areas of high relief. These ancient means are more primitive but are also more flexible. Sheep, goats, ponies and man are still the carrier of goods in highland areas. Passes are high and difficult and provide passage for some months of the year. Kangra Valley railway is the most scenic and the northernmost railway in India. It has helped to facilitate and stimulate travel and trade. Some extension of Kangra Valley Railway and the electrification would mean less costs and more trade. Electrification would save long haulage of coal besides eliminating smoke and reduce costs because of little expenditure of energy on downhill journey. Pathankot-Kulu road is the life-line of the region. Development of air-transport would be helpful to tourists and for the transport of perishable products like hill fruit. Present transport facilities are inadequate for the needs of the economy and severely limit development. Absence of roads has resulted in isolation and conservatism. Isolation is being broken as transport is gradually developing. The economy depends to a great extent on transport costs. In any scheme of development and planning, the development of transport and communications will occupy a very vital place in this region.

121. The accessibility by roads in South Bihar.

JAGDISH SINGH, Varanasi.

Most of south Bihar is included in the highly dissected plateau of Chotanagpur. The roads serve as the most important artery of transport; but over two-fifths of

south Bihar, still remains inaccessible by roads. Highly rugged relief, with steep gradients presented by scarps and depressions, of the Palamau upland, hilly Singhbhum and 'Pats' region of western Ranchi appears to have obstructed the development of road transport over considerable area. In the Ganga plain the main physical limitation is due to floods caused during the rains by numerous streams running parallel to each other.

The existing pattern of roads is influenced by three factors :—

(1) The existence of a series of towns like Varanasi (outside the state), Buxar, Arrah, Patna, Monghyr and Bhagalpur along the Ganga.

(2) The presence of some pockets of economically developed areas, like Dhanbad-Jharia-Sindri industrial area, Jamshedpur industrial centre, Singhbhum iron and copper mining region and coal mining centres in the plateau.

(3) The influence of Calcutta (outside the state) functioning as the chief of the region.

Moreover, Ranchi, the summer capital of Bihar, has become a nodal point in the heart of the plateau.

South Bihar may be divided into three belts from the point of view of accessibility by roads.

(i) The Northern belt (North of the G. T. Road) has the greatest accessibility where only 30.2% of the area is inaccessible.

(ii) The Middle belt (between the G. T. Road and Daltonganj-Ranchi road extended up to Silli in the east and Nagpur Uttari in the west), where 40.9% of the area is inaccessible. But the area to the east of the Hazaribagh-Ranchi road is greatly accessible in this belt.

(iii) The most inaccessible Southern belt (south of Dalt-Ranchi Road) where 60% of the area is inaccessible.

122. The Prospect of Developing Inland Navigation on Ganges in Uttar Pradesh.

Miss M. VATAL, Allahabad.

Inland navigation on the Ganges in U.P. has been dealt retrospectively, which reveals the existence of flourishing trade in the past. The trade and transport has declined since then, due to the withdrawals of water by the canals and the undue attention paid to the railways and roads in the last century. Since then the waterways have been allowed to silt, decay and die away.

In order to view the inland transport possibilities the Ganges is divided into three tracts : the Upper, Middle, and the Lower. The upper or the mountainous part is almost useless for the navigation. In the middle part, which extends from Hardwar to Allahabad, there is a possibility of making a navigational channel of 3 feet depth from December to June from Kanpur to Allahabad, only after improvements of shoals. The lower part is the most favourable part—extending for 232 miles from Allahabad to Buxar, because of its physical qualities and the prospect of potential trade through the river.

Competition is one of the major problems in the development of river transport. Due to government aid and initiative rivers can be made supplementary to the railways because there is a natural division of traffic between the two.

Recently the Government is taking interest and carrying out river traffic surveys which may help the development of the rivers as a water way.

Population Geography**123. A Note on the Anomalous Sex Ratio in the Population of Dehra Dun.**

MOHD. NASEER KHAN and RAMESH DUTTA DIKSHIT, Allahabad.

A very striking demographic feature of the population of Dehra Dun has been a marked anomaly in the sex composition. Throughout the recorded period from the arrival of the British to the present day the census statistics have recorded a marked deficiency of women to the total male population. Though there is deficiency of women in the population of the whole of the Western Plain of Uttar Pradesh, the deficiency is greatest in the Valley in question. Any serious student of population cannot but be struck and set thinking as to the social economic and physical causes which have brought about this. The present note aims at this very explanation.

Different speculations have been made and discussed with their merits and demerits and finally the conclusion arrived at is that the problem is a very complex one. While several social, political, historical and economic causes can explain part of the problem, the chief cause appears to be deep rooted. The anomaly is not superficial but inherent. Even at birth the males far exceed the female offsprings. The authors are, therefore, of the opinion that this anomaly must be related to some environmental element, some mineral constituent in the soil and the water of the valley as well as something in the very air and climate. Therefore, for a fuller analysis we need the help of a batch of expert chemists and medicalmen.

124. A Sample Survey of the Measurement of Resources in Relation to Population in a Semi Arid Region of Handwara, North Kashmir.

A. N. RAINA, Jammu.

In this paper an attempt is made at measurement of land resources in relation to population in the valley of Kashmir where an investigation of some importance was carried in various crop zones to determine adequacy or inadequacy of food. In a survey of land use, non-use and mis-use some villages had to be grouped together for purposes of generalised study like the Rice Kandy (Arid) Region, a collection of eight villages : Badrakal, Khirmen Telakchand, Waskura, Kachhwari, Bhagatpura, Khanabal, Handwara and Badakot. In this region the complex problem of nutrition was studied in view of insufficient food grains, vegetables, fruits, milk and sugar.

The method of measurement of resources was completed after ascertaining various calculations to show normal diet requirements per capita after equating the total population with the total cultivated area. The individual holding in the Rice-Kandy (Arid) Region, however, is a subsistence holding that supports one family. A standard nutrition unit of diet for rural Kashmir as a whole was worked out at 98,000; 20% less than one NU. It being difficult to ascertain a PPU for this region a general unit was worked out with an average stock unit per acre. Deductions were made after turning field yields into consumption figures and finally into caloric intake, and are, therefore, expected to present a more or less accurate index of food consumption in those regions of rural Kashmir where aridity prevails. An average intake of calories was determined from a careful study of articles that enter into normal diet as :—

Maize (flour or grained) $1\frac{1}{2}$ lb.

Vegetables $\frac{1}{4}$ lb.

Fruit $\frac{1}{4}$ lb.

Milk and Tea 1 oz.

(Meat and fish rarely but eggs often)

For want of amino-acids there is a poor-protein metabolism which hinders normal growth and development.

A careful interpretation of statistics reveals how an ever increasing population ultimately results in a lower standard of living with its ugly results. Not to be ruled out as a study of subjective judgment, this vital problem is to be studied in comparison with other parts of India and the World now that science and technology have shifted man-made frontiers far into space.

125. Demographic Features of Murshidabad (W. B.).

N. D. BHATTACHARYA, Varanasi.

The study of demographic features of Murshidabad ($24^{\circ} 12'$: $88^{\circ} 18'$) is necessary for the correct understanding of 'Social Morphology'. The physical setting, climatic conditions and historical facts bear a definite relation to the distribution and trend of population.

An attempt has been made to study the pre-census period with the help of the travellers' reports, historical references and plans. The Muslim ruler in the beginning of the 18th Century, was attracted by its natural barriers, healthy climate and central position; and there was a tremendous influx of population. The first reliable and regular census was taken in 1872.

The decrease of population may be attributed to the physical and political factors which have been analytically discussed in the paper.

After partition (1947) there was a considerable influx of rural population from East Pakistan. They are approximately 10,000 in number and are temporarily settled at Kurmitola (J.L.No. 64).

As regards the sex composition, Murshidabad does not show any marked difference. The town stands on the unhealthy zone of the 'Bagri', hence the mortality is high.

At present, according to the census, 1951, there are only 10,756 persons, excluding 'displaced persons' residing within the Municipal jurisdiction. The population of the town (50 Sq. Miles) has an agrarian base.

Murshidabad is a Sub-divisional Head Quarters of Lalbagh and 'Class IV' Municipal Town.

126. The Coin System in Population Mapping.

SIVAPRASAD DAS GUPTA, Calcutta.

The isopleth, choropleth and dot methods commonly used in population mapping are hardly suitable for satisfactory representation of population of a country, particularly of India which has extreme variations in densities. Usually, these methods lead to over-generalization of the pattern of distribution though detailed population figures are easily available. It is particularly difficult to show both the sparsely and densely populated areas and both rural and urban population equally well in a single map. Now that we have detailed village-wise population figures available for the first time covering the entire country, it is worthwhile to make a bold attempt to prepare a primary map showing distribution of population as exactly as possible by a suitable method. Investigations carried out in the National Atlas Organisation under the guidance of Dr. S. P. Chatterjee, Director, lead to the conclusions that the distribution of rural population is best represented by using

proportional dots in coin system, which can be combined, in the same scale of radius, with circles of continued proportionality showing urban population. The method has come to be known as coin system because dots of fixed values and proportional sizes are used comparable to currency coins of different fixed denominations.

In the population map incorporated in the English edition of the National Atlas of India coins of three denominations have been used to show rural population, the small one representing 100, medium 500 and large 1000 persons. The generally dispersed character of rural population and smaller settlements can be very well represented by the small coin, while the medium and large coins can show large villages and densely populated areas equally well. The size of the dots has been kept at the minimum level possible, considering the fact that the scale of the base map is not larger than 1M. Thus the small dot is only of .3 mm. diameter while the medium .7 mm. and the larger 1 mm. Moreover, by using two different colours, green and red, it has been possible to show rural population classified into two categories, agricultural and non-agricultural. Similarly, towns have also been shown classified into four functional types—industrial, commercial service and agricultural—each represented circle of different colours.

The technique of preparation of the coin map is somewhat complicated because the villages cannot be located straightway on 1M scale and because it is impossible to draw the dots of diminutive size as indicated above. The villages are first located and identified on one-inch topographical sheets. The positions of hamlets and habitations are then transferred on corresponding blue print copy of quarter-inch maps on which dots are drawn 4 times larger than the size of those on 1M scale; two complementary colours, red and blue, are used indicating agricultural and non-agricultural population. These quarter-inch originals are then reduced to .6M scale and, at the same time, the colours are separated photographically and two sets, for two colours, of reduced black prints are prepared. The prints are then pasted in position to form two mosaics which are subsequently further reduced to 1M scale and finally printed in green and red. The magnitude of this mapping project is immense. This involves drawing of some 2 million dots representing 300 million persons, plotted on sites of 558 thousand villages. This requires some 7,000 one-inch and other large scale maps for getting exact location of villages and entails preparation of more than 360 quarter-inch originals. This can keep a band of dozen workers busy for a decade.

The chief merit of the map is that here the actual pattern of population distribution is revealed, for the coins are plotted exactly on the sites of hamlets and habitations. By this method both sparse and dense distributions are shown equally well; since the coins and circles have the same unit of measurement the relative values of rural and urban population are brought out clearly.

Regional Geography

127. Flood : Its causes and control in Deoria District, U.P.

B. P. RAO, Varanasi.

Deoria district, through which the Saryu, the Rapti, the Narayani and the Chhoti Gandak flow has become the victim of highly disastrous floods almost in every monsoon season. It has been estimated that during the last fifty years the average loss of property by floods was Rs. 50 lakh annually.

The role of Nature and Man both in the recurrence of floods, in this part of the "Saryupar Plan", can be appreciated. After every heavy rainfall, (some times more than 17 inches during a short interval of 24 hours) particularly in the upper

reaches of the streams, which fail to drain out the excess rainwater which spreads over the tanks and floods of the adjoining areas. The rivers deposit a great amount of debris in their beds during the rainy season which helps in the choking of beds and as a result, the courses of the rivers are generally changed. Several earthen dams thrown by man across the streams to store water for irrigation and fishing, construction of narrow bridges, cultivation of the former river beds and the railway embankments, all make their contribution to recurrent floods.

Though man has little control over heavy rainfall, yet it has been found that adequate vegetation cover constitutes towards the regular and even distribution of rainfall. But in the district, people have done the greatest crime by clearing away the natural vegetation (in 1952 only 32 acres of land was under forest). Thus afforestation in upper reaches may minimise the recurrence of floods. Further, the floods may be controlled by constructing multipurpose reservoirs and canals, scientific bunds and regulator, renewal of cultivated drainage lines, introduction of river training scheme, establishment of flood warning centres and shifting of settlement at safe distance.

128. 'Bhitar Kanika'—A Geographical Study.

B. C. ACHARYA, Cuttack.

Bhitar Kanika is situated in the north and eastern point of the district of Cuttack in Orissa. It lies between the two important rivers—Brahmani in the north and its distributary Maipura Nadi in the south. It is the delta land formed by the above two rivers. The land has been dissected by innumerable channels of Bhitar-kanika Nadi and its tributaries, which are tidal in character. Land and water communications are difficult. It is more convenient to travel in country boats or motor launches than by any heavier boats.

The region enjoys Monsoon type of climate, moderated by oceanic influence. Pre and Post Monsoon storms of milder and sometimes of destructive nature pass over the area.

Silt and recent alluvium of riparian character form the main composition of the soil. The forest and the natural vegetation exhibit mangrove character. Cultivated crops are not grown due to lack of human habitation in the region. Spotted deer and wild boar in the forests and crocodiles in the river are the common animals of the place. Birds are common in marsh and swampy portions.

Bhitar Kanika has a wide scope for development as a tourist centre and a reserve of fire wood for the people of the neighbouring region, who experience great difficulties in collecting them. Moreover after land reclamation, the area can be developed for paddy and jute cultivation which will augment the agricultural production of the land.

129. A Note on the Regional Division of Mysore State.

V. R. PRABHU, Dharwar.

For a detailed work on the regional geography of Mysore State, necessity is felt of a suitable division. The schemes so far provided, such as those of Prof. Stamp or Prof. Spate, are obviously in outline. In this paper an attempt is made to meet this need.

The reorganised Mysore State covers parts of the three larger geographic regions of South India : the West Coast, the Sahyadries, and the Plateau. The primary division is complete if a fourth, the Transitional Zone between Sahyadries and the Plateau, is added.

In this scheme, the four primary divisions are subdivided into nine smaller divisions, which are further resolved into seventeen different regions. In the naming of these, due attention is paid to the *nom-de-pays* which are long established. It is believed that these will provide the necessary basis for further work in the regional geography of Mysore State.

130. Western Rajasthan : A Study of Rural Settlements.

RAM CHANDRA SHARMA, Allahabad.

In the anatomy of the rural landscape of Western Rajasthan, this study is concerned with three aspects of its cultural features : the demographic trends in the area, the types and patterns of rural settlements and the house types, on the regional basis. The main outline of the present network of rural settlements in Western Rajasthan covered practically by wind blown sand except 5100 square miles of tract of rocky outcrops—was laid down in feudal times of Medieval or Proto-Rajput and late Medieval period up to 1857 though there are traces of the settlements of the 'Indus Valley Civilisation dating back to 3000 B.C.—2500 B.C.

The demographic trends and rural population distribution is greatly influenced by physical and climatic environment of the area where in the nucleation of rural settlements, the under ground water table plays most significant role. The types of pattern of Rural settlements consist of wide variations based on Pastoral-cum-Agricultural Economy, topography of the area, the famines and internal feuds; present expansion of means of communications and recent irrigational facilities. The whole tract is divided into various regions on the basis of rural dwellings and street pattern, in which from compact to semi-compact hamletted type is predominant one. The Rural housing of Western Rajasthan is deeply influenced by physical conditions of the tract, having from mud-walled tiled roofed houses to stony slab roofed houses and kacha circular Zupas, the most feeble type of human shelter against scorching heat and hot wind.

So, the mark of water and its availability is great in the nucleation of these rural settlements of Western Rajasthan. These settlements and their pattern and house types are most peculiar of this arid division of the country.

131. The Soils of the Moradabad District of Uttar Pradesh.

S. L. DUGGAL, Muzaffarnagar.

The Moradabad district forms a part of the Gangetic lowland in the north-west of Uttar Pradesh. It is drained by the Ganga, the Ramganga and their numerous tributaries. The rocks of the district represent the sediments brought down by the rivers from the northern mountains and deposited here. Over the alluvial base there is a sheet of aeolian deposits, particularly, in the western parts.

The climate of the district is marked by a great variability of rainfall and alternation of wind systems characteristic of the monsoonal climate.

The soils of the district are transported soils : alluvial and wind-borne, mostly clay, loam and sand. Variations in soil fertility are mainly due to the water table and the presence of calcareous or saline matter in the soil. They are rich in potash, phosphoric acid, lime and organic matter.

No attempt has so far been made for acquiring the scientific knowledge of the soils of this district. The farmers recognize a multiplicity of them through their day to day observations and experiences. The land revenue classification of the soils is based primarily on the size of the particles found in them. The soil demarcation in 1904-05 recorded 11.83% clay, 20.22% bhur (sands), and 67.81% loam or

dumat. The medium grained dumat soils are the normal soils of the bhangar uplands. They are easily tilled and their moisture content is usually sufficient for the growth of foodgrains without irrigation.

132. A Comparative Study of Soils formed from different Parent Rocks.

S. P. CHATTERJEE, R. LAHIRI and S. VENKATARAMAN, Calcutta.

Soils are formed from the fragments of rocks and minerals (belonging to the *lithosphere*) and from the products of their decomposition. The relative rate and importance of the different processes involved in the process of soil formation vary according to the nature of the climate of the place concerned. The process of mineral decay is commonly associated with the removal of basic elements like Ca^{++} , K^{+} , Na^{+} , and Mg^{++} from the minerals. A large part of the negative radicals of the minerals belonging to the group of silicate remain as hydrated alumino-silicates, together with SiO_2 , Al_2O_3 and Fe_2O_3 in various stages of hydration. The result of soil forming forces which operate on the parent rock for quite a long period of time is in the development of the so called *soil profile*. Along with the weathering of the parent rock the processes of mechanical and chemical eluviation and illuviation give rise to a differentiation in the soil body. From the study of large number of soil profiles in different climatic regions of the world, it has been shown that the variations in the nature of the different soils are primarily due to the variations of climate from the equator to the poles; thus the major soil groups of the world are zonally distributed. These are typical climogenetic soils. In the earlier stages of the formation of the soils, the influence of the parent material may be seen to influence to some extent but with passage of time the climatic influence stands out as dominant. On the other hand, when the influence of the parent material is dominating, the type intrazonal or endodynamomorphie soils are formed.

In this paper, two soil profiles studied in the District of Bankura, West Bengal, have been discussed to bring out the influence of parent rock on some of the salient properties of the soils. It has been shown that the texture, the thickness of the soil profiles, the presence of a CO_2 -- enriched horizon, soil reaction, the base exchange capacities etc. could be directly correlated with the composition of the parent rock. The ultimate test will be made by the differential thermal analysis and 'x' ray analysis of the soil clays which are now under investigation.

133. Study of Organic Matter in Howrah Soils.

S. N. MUKHERJEE, Calcutta.

Humified organic material present in the soils of Howrah district in West Bengal was studied. It was found that though the average amount of organic matter present in the surface soil is roughly 2%, it is not uniform throughout the entire district. Micro relief feature of the soil, the nature of vegetation there and the clay content of the soils are some of the factors responsible for this variation. These are explained with the help of analytical data. According to the comparative study of the organic matter profiles, it is observed that they can be arranged in four distinct groups viz., (i) where the amount of organic matter in the soil profile decreased from the surface downward, (ii) where the percentage of organic matter first decreases, attains a minimum value and then increases; (iii) where the amount of organic matter first decreases, then increases and finally decreases again; and lastly (iv) where there are two zones of organic matter depletion and enrichment. The nature of variation of organic matter within the profile, particularly the zone of accumulation, is either due to the change of soil PH and water tables, or due to buried soil profiles.

Land Utilisation**134. Correlation of Slope and Land Use on Vindhyans near Mirzapur.**

VIJAYA RAM SINGH, Varanasi.

In this short study, an attempt is made to correlate the influence of slope on land utilization, along the outer scarp of Vindhyans adjacent to Mirzapur town.

The slope category and land use maps have been separately prepared and superimposed and the following conclusions have been drawn.

Taking slope into account it appears that the cultivation predominates continuously on the normal slopes (1 in 120) and in small patches on the moderate slopes (1 in 40-120). Open scrub mixed with forest covers moderate slopes and rarely on high slopes (1 in 30-40). Grazing is uncommon on high and steep slopes (1 in below 30) which are mainly wooded.

135. The changing Land-use Pattern in Chakia Tahsil of Banaras District.

BASANT SINGH, Varanasi.

Chakia tahsil of Banaras district (24°4' to 25°3' north latitude and 83°3' to 83°24' east) embraces an area of 474 square miles. Out of which one-third falls into the Ganga plain and the rest forms the part of the Vindhyan plateau. Due to the rugged nature of the topography, inaccessibility and infertile soil, the Vindhyan plateau does not show significant changes in the land-use pattern since 1881. Only some agricultural patches have developed along the foot hills due to the reclamation of the forest, whereas in the Ganga plain considerable changes have occurred during that period, mainly on account of the improvements in irrigational and transport facilities and growing pressure of population. Hundreds of acres of land, not available for cultivation, have now been brought into different uses, such as new irrigation offices, roads and new settlements etc. Area under food crops have been increased and a considerable area has been reclaimed by clearance of the forests for agricultural purposes.

136. The Historical Factor Governing Land Use Pattern in Moradabad District.

S. L. DUGGAL, Muzaffarnagar.

Moradabad district, properly spelled Muradabad, forms a part of the historically famous region Rohilkhand, which lies in the north-west of Uttar Pradesh and along the left bank of the Ganga river.

The district was, perhaps, occupied in the pre-aryan times since when many races have come here one after the other. About the 11th century A.D. there seems to have been an extensive colonization of the area by various tribes of the Rajputs, among which the most important were the Katehrias who have given their name to the bhangar uplands of the area. The Sultans and Emperors at Delhi sent various expeditions against the freedom loving Katehrias. Many times the whole country was laid waste. It was at this time that for the jungles here were cleared since they served as an easy refuge for the Katehrias. The district remained turbulent during the Moghul period and was again disturbed during the period of the decline of the Moghuls.

The present day pattern of land use started when the British Crown had enforced peace over the country. It has continued until the Five Year Plans of Independent India have begun to bear fruit.



137. Land-Use and Agriculture in Kangra Valley.

V. P. KAYASTHA, Varanasi.

The important feature of land-use in Kangra valley is the large percentage of uncultivated area. It occupies 45.58% of the whole area. Unappropriated government waste and forests etc. occupy another 31.92% of the area. Uncultivated areas, wastelands and forests occupy more than $\frac{3}{4}$ th of the total area. The cultivated area is restricted amounting to 22.5%. Nonetheless, agriculture is the chief means of sustenance because of the absence of the secondary means of occupation. Agriculture employs more than 90% of the population of the valley. Thus, the pressure of population on cultivated area is very high amounting to as much as 1,250 persons per sq. mile of cultivated area. The valley has also got large number of livestock and there are about 3 heads of livestock per cultivated acre. Such high density of livestock has led to damage to natural vegetation causing soil erosion and subsequent loss to agricultural land. Agriculture is not prosperous because of uneconomic small holdings. In certain areas the fields are so small that agriculture is done with the hoe. One of the redeeming features of agriculture is the large percentage of irrigated area which is as high as 68.2%. Kangra valley has thus become the granary of the hilly and mountainous regions of Kangra.

138. Kachhwa : A Study in Changing Landuse.

VIJAYA RAM SINGH, Varanasi.

This study deals with the changing pattern of land utilization during the last 120 years, in an urban centre (rural urban)—Kachhwa (area : 1260 acres) which lies 12 miles north-east of Mirzapur. About two-thirds of Kachhwa form a part of the 'Khadar' and the rest, a part of 'bangar' plains of the Middle Ganga Valley.

This settlement grew as a military camp and a small market place. Earlier it supplied indigo and cotton to the Mirzapur carpet industry. With decline of the carpet industry indigo and cotton cultivations disappeared. Later the indigo factory was turned into a hospital. Recently it has shown rapid progress and has now attained the first stage of urbanization (Town area). Population has increased by 50 per cent and the non-agricultural population increased by 100 per cent since 1881.

The southward shift of the Ganga has provided an area of 105 acres of additional land leading to changes in field patterns. The expansion of non-agricultural functions with the growth of population caused considerable increase in the built up area. A variation in the land ownership is also notable.

A significant change in crop patterns is also marked. In 1839-40, indigo, millet, 'benjhar' and barley were predominating which were replaced by mixed cropping of cotton-arhar, wheat and barley in 1879-80. In 1957-58 all the prior crops were almost vanished and new crops like rice, maize, hemp, potato, tobacco and fodder crops have opened a new chapter in the present land use pattern of Kachhwa.

These changes in land use pattern have been due to the following facts : ever shifting nature of the Ganga ; increasing concentration of non-agricultural functions ; fluctuating fortune of Mirzapur and the changing land laws in different periods.

139. Cultural Landscape of South Ganga Plain, Bihar.

RAMESHWAR PRASAD SINHA, Gaya.

Man has utilised the natural landscape for making it a suitable abode. The plain forms rich cultivable tract in the State of Bihar, where variety of crops are grown to feed the present and adding months.

The country, with varying pattern of fields, has not only been netted with roads, railways, telegraphs—poles electric grids, but has also been painted with different sizes of rural and urban settlements. The land which has been used to different purposes is given below :—

1. Net area sown	...	...	...	...	59.10%
2. Current fallow	...	...	...	...	6.40%
3. Uncultivated land excluding current fallow	..	...	...	...	3.90%
4. Not available for cultivation	...	..	...	...	12.70%
5. Forest	...	...	...	...	12.90%
					<hr/>
					100.00%

This rich cultivable tract is one of the densest area of India. The density varies from 200 to over 2,000 persons per square mile. The areas, lying between the flood plain and the hilly tract, show a high density, but the density decreases from east to west and from north to south. There are eleven density regions.

Classifications of Settlement by function show that about 80% of the inhabitants of South Ganga plain of Bihar are agriculturists and the rest are devoted to mining, quarrying, industries, commerce and transport. Rural centres outnumber the urban nucleous. The size of the rural settlements vary from one area to the other giving a variety of rural patterns. Patna and Gaya are cities with different functions, where as major and minor towns are distributed in different parts of the country, functioning either as administrative educational or collecting or distributing centres.

Communication lines spread like veins in the body of the region. These cultural features are painted on the Natural landscape, which constitutes the cultural Landscape of South Ganga Plain of Bihar.

140. Land Capability Classification in a Canal Irrigated Area of the Patna District, Bihar.

R. N. P. SINHA, Patna.

The group of eight revenue villages (25°30'—25°35'N. : 84°59'—85°4'E.) chosen for study lies in a north east—south west strip along the Kurkuri distributary of the Son East Canal. This comprises a total area of 4301 acres of which more than 86 per cent is cultivated leaving only about 14 per cent for other uses.

The area has some uplands and lowlands carved out by the westward shifting course of river Son. The climate is sub-humid with an average rainfall of 40" coming mostly in summer and temperatures varying between 84° in summer and 50° in winter.

Five soil types have been distinguished viz. clay, clay loam, sandy clay loam, sandy loam and loamy sand. There is no serious problem of salinity or alkalinity but organic matter and phosphoric acid are deficient. There is no serious problem of soil erosion and the depth of the soil is everywhere good.

Based on these physiographic, climatic, edaphic and hydrographic factors, the land of the area has been classified as follows :—

CATEGORY I. Good Quality Land.

Class I. Nearly level, highly productive land with clay loam soil suitable for a large number of crops.

Class II. A bit higher in elevation with sandy clay loam soil liable to rapid percolation. More suited to market gardening.

Class III. Lowland with sandy loam soil subject to water-logging and slight acidity. Moderate yield.

Class IV. Lowland with clay soil having poor permeability. Range of crops limited. Suited mostly to 'rabi'.

CATEGORY II. Medium Quality Land.

Class V. Upland with light sandy loam and defective water conditions.
Medium productivity even under good management.

CATEGORY III. Poor Quality Land.

Class VI. Driest upland with loamy sandy soil. Water draining out freely.
Suited to vegetation.

CATEGORY IV. Not available for cultivation.

Class VII. Comprises house-sites, roads, ponds, etc.

141. Morphology and Change in Land Use Pattern near the Jhelum Gorge in Baramulla, Kashmir.

A. N. RAINA, Jammu.

This paper deals with morphology and basic factors affecting type and success of land use near the Jhelum Gorge (Bahramgol), in Baramulla Kashmir, lying between latitude 34° to 35° North and longitude 74° to 75° East and reveals an interestingly diverse physiography.

The morphological study covers the villages of Chakla, Nadihal and Saadipora. Geologically the original lake of the Kashmir valley forced its way out of the gorge at this place draining the oval vale in which, finer sediments were deposited forming Karewas at the foot of the mountain ranges. Rich in alluvium, deposited after frequent floods in the past, Chakla is a typical river-bank village in the lap of a loop of the Jhelum. Scattered on the southern slopes of a hard and worn down Karewa is Nadihal, a fairly large village, Saadipora is another village fifteen feet above the level of Chakla. The slope is towards the east into a plain which further ends into a swampy area of the Wular Lake.

The soil composition in this Rice-Fruit Region varies from deep alluvium which when dry is soft clay without sand to dry clay towards higher elevations of Nadihal and Saadipora. Right use has been made of everything by the hard working villagers that could help them in enriching the soil from the hair of a sheep to a corpse. Even the decomposition of human refuse with soil and grass is used along with chemical fertilizers. The transplantation method of sowing has given good results with a deep ploughing to prepare the solid bed in spring when snow and ice has melted. The thawing pulverises soil and the fields are prepared with farm yard manure.

The land use pattern of this region has altered since the First Five Year Plan when the geographical factors of this region changed as a result of lift irrigation worked at present with diesel pumps and to be worked with electricity when the entire region towards the elevated fans of the Karewa near Nadihal will also get water for irrigation. Lift irrigation has helped the agricultural economy of this region which is now changing its shape and undergoing a revolution. More than five hundred people out of a population of about 3,000 travelled long distances to earn a living mostly by preparing rafts and arranging logs of wood for being floated to the city of Srinagar. They are settled farmers now.

No more maize and fruits but rice cultivation has been possible in this area where the rich soil bed being still virgin gives a high yield of China paddy which is preferred for its ease of cultivation. The population has suffered a revolution with rice as chief article of diet and a considerable increase in livestock has begun to be looked after carefully by the peasant whose resources have suddenly increased and for whom the vexed problems of increasing pressure of population, fragmentations of holdings, the poverty of the soils will crop up very late and may not cause that depression of anxiety for the help which rationalization and scientific methods may keep at his disposal. Since much of rice land is double or even triple-cropped

yield will be enormous in future when labour and capital will be available. In this respect adaptation to a sudden increase in resources has not taken place.

Much of mobility of labour has ceased in this region and the waste of time and energy per capita has been reduced and profitably employed in productive enterprises. The advantages of settled agriculture like the full time farm work, more attention to cows and oxen resulting in an increased yield of dairy products and dung together with fresh vegetables have increased the carrying capacity of the earth.

A tendency towards the expansion of the villages to higher elevations is seen though the main road has attracted habitation for its ease of trade. The two maps show how far cultivation has extended towards the fans of Karewas and land previously poor, dry and dusty is now a potential production unit with considerable future possibilities.

URBAN GEOGRAPHY

142. Sankarpur—a market gardening area in Cuttack city.

RABINDRANATH RAY, Cuttack.

Sankarpur, an important market gardening area in Cuttack city is lower than the surrounding tracts and has small depressions, containing water locally known as "Garhias". There are a few swamps and patches of unused plots with short, hard grass.

The factors that have developed market gardening here are (i) presence of moderately good soil, locally known as 'Telbalia' a mixture of sand and clay and rich in humus, (ii) the proximity of the subsoil water, which lies at a depth of 6' to 10', (iii) nearness to Taldanda canal, (iv) nearness to the wholesale vegetable market of Chattra bazar, so that transport costs are very slight.

Poultry farming and pastoral occupation are entirely absent.

The vegetable gardens are invariably situated near the 'Garhias'. Water is lifted by means of a 'tenda' from these 'garhias'. The fields are bounded by thick hedges of 'Nagoi' plants. Each field is divided into tiny subplots of varying size which raise different vegetables. There are two main crop seasons : (i) The Jonhi or the Jhingi season during the rains, (ii) The Cabbage—Cauliflower season during the winter. Except these crops a variety of pot herbs like Pui, Lautia, Pudina, Kosala and Dhaniapatra, Jhurunga—a kind of beans, pumpkin and gourd, water-melon, potatoes and brinjals are grown. The cultivation is of the intensive type and there is widespread use of both natural and artificial manures.

The area has a great prospect in view of the ever-increasing need for fresh vegetables for the citizens of Cuttack. Poultry farming and pisciculture are possible and should be undertaken.

143. Trends of Urbanization in Dehra Dun Valley.

RAMESH DUTTA DIKSHIT, Allahabad.

In the present paper an attempt has been made to trace the growth and trends of urbanization in Dehra Dun Valley from the ancient times to the present day. The paper starts with tracing the probable growth of the first agglomerated settlements—the rudimentary towns—which it is thought might have grown in the Asokan times. Though some rudimentary towns might have existed in the times of Asokan supremacy in the Dun and certainly some flourished from the 12th to the beginning of the 18th century, but many were deserted and all decreased in importance from

the mid-eighteenth to the first quarter of the 19th century when anarchy and maladministration prevailed and there was insecurity of life and property all round. Thus true urbanization may be said to begin only after the British arrival in the Dun and most of the present towns are the product of the British rule.

Demographically Dehra Dun Valley is one of the most urbanized parts of the State. With 47% of its people living in cities and towns of different categories against 13.6 per cent average for the State; it is far more urbanized than the whole of the Uttar Pradesh. Here urbanization has been very steady and speedy; where as in 1901 only 22 per cent of the people lived in towns, today half of the population is urban dweller. The net variation in urban population of the valley from 1901-1951 has been 434 per cent where as the total population has recorded a positive variation of only 209 per cent during the same period. The census of 1951 records one Class I, three Class V and two Class VI towns in the Dun. The growth of population has not been uniform in all the towns. The different causes for this have been briefly dealt with.

Besides demographic trends, a study of the trends in the locational alignment of towns has also been attempted. Formerly the urban centres that existed were mostly in the Eastern Dun but after the British arrival the new centres that grew has a marked westerly alignment in their location. The politico-economic causes for this have been amply explained.

The future appears to have much in store for the urban developments in the valley.

144. Growth of Mussooree as a Hill Sanitorium.

RAMESH DUTTA DIKSHIT, Allahabad.

Situated in latitude 30° 27' North and longitude 78° 61' East at a distance of fourteen miles from Dehra Dun and standing at an average elevation of 6580' above sea level, Mussooree is one of the most popular hill stations of India. The paper starts with a brief discussion of the nomenclature of the town and the different factors in its growth from the early years to the present day have been sufficiently explained. Like most of the hill station of Northern India Mussooree is a product of the British rule.

The European engineers in Dehra Dun were anxious to find a cooler place where they could go during the summer months and after a great deal of exploration the present site was chosen. The station may be said to have come formally into existence in the year 1823.

Prior to the growth of the modern township of Mussooree the hills where the town now stands supported no permanent human habitations. The whole area was studded with cowsheds showing the rights of individual farmers on the flat patches of land surrounding each shed. There cattle were grazed in summer. The advantages of Mussooree as a hill sanitoria having been recognized, it did not take long to flourish. Soon land was bought from the farmers and small and beautiful cottages sprang up on all sides where our white masters began to settle in good numbers. For the amenities and entertainment of the European settlers and the education of their children, all sorts of shops, clubs and schools were opened and the town grew with great rapidity. Thus Mussooree developed into a miniature model of an occidental town on the oriental soil of India. Various economic and historical factors such as opening of the Dehra-Haradwar Railway, stay of Yakub Khan and the Duke and Duchess of Cannaught etc.—gave added impetus to the growth of the township.

Of greatest import in the growth of the town are the geographical factors but for which Mussooree could never have been so popular and so attractive. These

factors have been fully discussed here. Its easy accessibility, healthy climate and pure water as well as the captivating scenery it commands, all have contributed to make Mussooree what it is today.

The paper ends with a note on the factors, which, in spite of all its advantages, have made Mussooree lag behind Naini Tal, the summer capital of the State, which chronologically started much later.

145. Evolution of Bangalore City.

R. L. SINGH, Varanasi.

Bangalore is an example of a ridge head town which has grown up at an elevation of about 3,000 ft. above sea level lying as it does in the centre of South Deccan at a distance of over 200 miles west of Madras. Though situated in a tropical country, the city enjoys a salubrious climate comparable to temperate regions. It has its origin in the second quarter of the 16th century (1537) with a mud fort as nucleus built by a Hindu ruler, Kempe Gauda. The old town was surrounded by a wall, ditch and hedge with at least five gates. The growth of the town could not be restricted to the limits set by four Kempe Gauda watch towers built at the cardinal points. The town passed into the hands of the Muslim rulers in the twenties of the 17th century; and particularly in the reign of Hyder Ali the fort was rebuilt with stone and the famous Lal Bagh garden was laid. The city began to experience new light in the first decade of the 19th century (1807) when a civil and military station was established by the Britishers and the cantonment began to develop as a twin town occupying a higher site (High ground) than that of the old town. Now the town has grown into a corporation and a million city faced with the problems of water supply, overcrowding, slum clearance etc.

146. Urban Land-use of Jaunpur.

HARI HAR SINGH, Varanasi.

Jaunpur (25° 45' N. and 82° 41' E.), an ancient city of mediaeval name, stands on either side of the river Gomati. Though the city is one of the important urban centres of Eastern U.P. (second only to Varanasi in the primary upland of Banaras), it has more of rural character. About 59% of its area is under cultivation. Market gardening deserves special mention as 70% of the agricultural land falls under this head.

The main built-up area is concentrated on the northern side of the river. Here lies the business district of the city covering about 1/3rd of the main built-up area. While roads and streets cover only 1% of the municipal area, about 7% of the land lies waste or is used otherwise.

With a view to accommodating growing population and to improve the condition of blighted areas, it is highly desirable that several housing schemes be established in the outer and suburban zones of the city. Moreover, establishment of an industrial colony in the outer zone, widening of roads, building of new modern markets in the city proper and provision of more civic amenities, will go a long way in improving the general character of the city.

147. The Influence of Railways on Townscape of 'KAVAL' Towns in U.P.

UJAGIR SINGH, Varanasi.

Since its appearance in the third quarter of the last century, the railway has very strongly influenced the structure and development of 'KAVAL' towns. The

railway lines in Allahabad, running through the heart of the city on high embankment with a few underpasses and subways, serve as a cultural divide between the city proper and the newer settlements developed near the railway stations. The embankments obstruct the natural drainage and traffic movement.

Railways form a large ring round the city of Agra. While the industrial zone stretches along the bank of the Yamuna near Agra City Station, most of the educational institutions occupy the western part of the outer zone served by Raja Ki Mandi and Idgah railway stations.

In Varanasi, the main built-up area forms a large triangle, the base of which lies in the north along the railway lines. While the two railway stations (city and Kashi R. S.) on the eastern margin of the base have facilitated the development of Visheshwarganj grain markets and a cotton mill, the civil lines and the cantonment have developed north of the Varanasi Rly. station in the west.

Railways in Kanpur have influenced the industrial landscape more than any other development. The industrial zone of the city has been shifting south and southeast wards, being attracted by railway stations. The railway sidings running through densely settled areas in the north, creates serious traffic problem.

Townscape of Lucknow is comparatively less influenced by railways running farther south from the main built-up area as sufficient land was available on either side of the Gomati. The metre gauge railway line running across the main built-up area, is proving a great nuisance to the public.

Under the circumstances, remodelling of railways must form an essential item of planning and development in each of the 'KAVAL' towns of U.P.

148. Urban Features of Bijapur, the Historical Town in Mysore State.

M. S. HONRAO, Dharwar.

Bijapur is the premier historical town of the north Mysore state. It is also the leading city of the Krishna-Bhima doab.

In an apparently unfavourable country, it must have been a small agricultural village. Its nodal situation and agricultural possibilities seem to be its original *raison d'être*, and not the purely historical accident which helped it to gain the status of a capital in the Musalman period. The contemporary rulers realised the advantages of the underlying trap for raising lasting buildings and structures. Even though the historical causes reduced the city's importance to almost a nonentity, the town today bears an unmistakable historical impress on its landscape.

It has taken a second lease of life as administrative centre but in full conformity with the modern conditions. Though it is today commonly known as a tourist centre, it has also acquired a legitimate importance in trade and has picked up some industry. It admirably illustrates the process at work in the transformation of such old centres.

149. Towns and their Umland in Western Rajasthan.

MOHD. NASEER KHAN and RAM CHANDRA SHARMA, Allahabad.

The object of the present paper is to focus attention on the Rajasthan Desert and to investigate the general pattern of growth of urban centres in relation to their local and regional environment. The goal of the investigations is to interpret the inter-relationships of some of the innumerable factors which constitute the regional and inter-regional complex of these widely scattered centres. This dry area division of the state of Rajasthan because of its pre-existing trade and market towns ranks second in order of urban density pattern and urban growth.

The urban centres of the Western Rajasthan owe their origin and location to diverse physical cultural and political factors. The history of time and space in their development played a great role and witnessed the diversity of unproportional growth of various types of towns of this region. The effect of time and space upon the personality of these towns has been clearly revealed in their morphological analysis and development in which both centripetal and centrifugal forces have been at play. Individually each and every town of this environment and responded perfectly to the tempo of the regional culture economic status. The demographic trends of these centres kept pace with the general character of their respective regional complex of environment. The sub regions of this dry division of Rajasthan, have fully affected the growth and the development of these widely scattered urban centres and takes us back through out the history for its explanation.

150. Suri—An Urban Study.

DIPTIMOYEE DEBI, Calcutta.

Suri is one of the most important town of Birbhum district of West Bengal. The area of the town is expanding with the growing population. The paper delineates all the important factors of urban growth. The paper also describes the detailed land use pattern of the town. The most important feature of the town is rural-cum-urban pattern. The Urban growth has been rapid since the introduction of Mayurrakshi Project. The transport system is not very well developed. The streets are narrow in the old town and wider in the extended area. Suri has got a permanent market and it attains the urban character.

151. "Industrial Landscape of Lucknow".

S. P. SINGH, Varanasi.

Lucknow, the capital of Uttar Pradesh, lies on both the banks of the river Gomati (26° 52' N. and 80° 65' E.). Its main functions are essentially administrative and commercial, yet its industrial function is not insignificant.

With the downfall of the Moghal Empire under the patronship of Nawabs of Avadh, it became an important centre of Cottage industries. Nawab Asafuddaula transferred Avadh's capital from Faizabad to Lucknow (1775). He encouraged many traders and craftsmen to reside here.

Later on, in the British regime the factory industries were also introduced, such as paper and cotton textile. Recently, the introduction of engineering industry has hailed a new era. And, now a new industrial colony of Aishbagh, though still in immature stage, can be identified within the urban habitat, where industries like iron and steel works, cycles and cycle parts, hume pipes, tube-well equipments, surgical instruments, agricultural implements, quality torches, chemicals, ice factories, flour mills, oil mills, Cotton textile and hurricane lanterns etc. are concentrated. But Lucknow still boast of its art and luxury products, such as chikan embroidery, kamdani, clay modelling, tobacco and perfumes, etc.

Including the Railway workers the heavy industries employ only 2.2 per cent of the total population and 33.6 percent of the total industrial population. The light industries employ 2.6 per cent of the total population and 40 per cent of the total industrial population. And, the cottage industries give employment to 1.7 per cent of the total population and 26.8 per cent of the total industrial population.

Most of the industries are using electric power.

152. Industrial towns of Uttar Pradesh.

KASHI NATH SINGH, Varanasi.

With a view to specifying the industrial towns of Uttar Pradesh a quantitative procedure has been followed. Taking the average percentage of the urban population of the State engaged in 'Production other than cultivation' (24.94%) as a reference tool, these categories of standard deviation (SD) have been calculated and individual towns have been rated by categories. Out of a total number of 467 towns of the State, only 111 or about 24% towns have their population engaged in industries above the State urban average, and only twenty six or 5.57% of the total, as they fall in SD₁ category (35.64%) and above, have been recognised as 'industrial towns'. Two more SD computations (SD₂—46.34% and SD₃—57.04%) have been made and towns classified accordingly. Eighty five towns, however, come to the average scale, while seventeen occur in SD₁, four in SD₂ and five in SD₃.

It is obvious from detailed analysis that urban centres and smaller towns appear to have more industrial bias due to their long-established cottage industries. Larger towns and cities, on the other hand, have multi-functional activities and, therefore, the percentage of their population engaged in industries is comparatively less.

Only Kanpur, Modinagar and to some extent, Firozabad represent, in the true sense, modern industrial characters in the State, while others are centres of cottage industries. This is further expressed by more rapid and steadier growth of the former as compared to slow and highly fluctuating growth or sometimes actual decrease or stagnation of the latter and also by comparatively larger male-female ratio in the former.

On the whole these 26 industrial towns comprise about 12% of the total urban population, and have recorded the highest growth (172.34% net) during 1901-51 as compared to other service centres of the State. There are, however, very few towns of industrial origin in the State.

153. Slums of Lucknow.

M. N. NIGAM, Varanasi.

Lucknow, though the capital and the most beautiful city of Uttar Pradesh, has several stinking spots of sub-human habitations in the shape of hutment slums. These slums are found in certain localities situated in the inner and middle zones specially in the west.

Survey, carried on in twenty slums consisting of 1860 houses and 9680 people reveals that 75% of the lanes and streets are Kachcha; only 20% have drainage facilities and 65% of the huts have open frontage. Only some of the slums have a few latrines and water taps with an average of 400 persons per latrine and 200 persons per water tap. The huts of these areas, inhabited by bad economised people, are low hovels, built of mud and stone, or bamboo and matting.

The influx of low-caste poor people for getting employment, lack of building-space and planning are the chief causes of these slums.

The insecurity and apathy in these areas have brought family disorganisations and disintegrations, neglect of the child, rise of prostitution, crime, the deterioration of youth, inefficiency and the resulting anti-social outlook, behaviour and activity.

The measures suggested for slum-clearance, include the engineering operation of these slums by means of different housing schemes, provision of civic amenities and proper planning.

154. The Concept of Functional Zones.

K. R. DIXIT, Baroda.

Many geographers for quite some years have been indiscriminately using the word 'Functional Zones' to emphasise the gregarious nature of functions in the urban complex. Obviously, it appears to have been repeatedly done to systematise the distributional pattern of functions over the city. An attempt has been made in this paper to review historically the development of the concept of functional zones and its application in the current studies of the urban functions. The validity of demarcating functional zones on the outline map of all the cities has been critically examined with reference to certain important studies of towns made in the past which show that the functional zones are not an universality and the heterogenous distribution of functions does not lend itself to clear-cut demarcation of functional zones on the map without an appreciable distortion of facts. Since the use of functional zones is so general as to frequently become faulty it is essential to support the generalisation by sample studies that will have the two-fold functions of giving the idea of general pattern of land use in an area and also providing the base for the determination of functional index which is to be expressed in terms of percentage of floor space devoted to one particular function as compared to the total occupied floor space in a locality. The functional index will give the relative importance of one function in the smallest demarcated unit area over the city. This is specially needed while dealing with the Indian cities where segregation of functions leading to perfect zoning has been well nigh impossible.

The terminology in this connection has not attained a set pattern. The synonymous use of functional zones, regions and areas has resulted sometimes in creating confusion and conveying meanings different from what they are supposed to convey. It is better if the use of functional zones is dispensed with in favour of functional areas which is much in line with the objective of the geographers.

The cartographic presentation of functions is suggested to take the form of several maps in place of one, each showing the distribution of one function by shading. The intensity of shade in every locality will indicate the magnitude of functional index. This method however, entails the work of sampling and cannot be done by simple street observation.

155. Classification of the ports of India based on site and Location.

S. M. KARIMI, Patna.

The old historic ports of India have all lost their importance to-day. The location of ports in the past were influenced essentially by productive hinterland, but to-day, barring a few exceptions only favourable sites can maintain first class ports. The result is that though India has a long coast-line, her sea-borne trade is carried on through only a few ports; these too suffer from certain defects with respect to their site.

The west coast, a block coast of recent faulting with rocky and erosional shore line and open to the action of the persistent South west monsoon gales is suitable only at places where some creek or the headland has enclosed a portion of the sea (Bombay), affording deep and safe anchorage. Changes in the physical conditions in the western north, such as, subsidence and elevation and huge sedimentation of the coast are responsible for the decay of old portsites (Broach & Surat). The eastern coast with raised seafloor and prograding deltas is dotted with only open sea roadsteads or artificial harbours.

Based on site and physical location, it is possible to divide the ports of India into three distinct groups, (a) ports with natural harbours affording a deep and safe anchorage for large modern vessels, such as, Bombay, Cochin, Kandla, Okha etc., (b) Ports, as open roadsteads lacking harbour or safe anchorage and used only in fair weather, dotting the west and the east coast of India and engaged essentially in the coasting trade. The two exceptions are Madras and Visakhapatnam which now possess artificial harbours, and (c) River ports, located along the bank of a river at its mouth or inside off the shore, being busy with coasting and inland trade with lighters and country boats. Calcutta on the Hooghly, however, maintains its importance by constant dredging of the sandbars of the river.

156. Delimitation of the Hinterland of Visakhapatnam Port.

B. P. RAO, Varanasi

Visakhapatnam, one of the youngest port of India occupies the fifth position among the "major ports" of the country. Situated on the east coast, 545 miles S. W. of Calcutta and 484 miles north of Madras, it has become the main outlet for a large area in between the above ports.

Considering the criteria suggested by Weigend and Morgan for delimiting the hinterland of ports, an attempt has been made to limit the hinterland of Visakhapatnam port. Considerations of Physiography, nature of means of transport and accessibility and some selected articles of outbound trade, like manganese, iron ore, leather and oil seeds, appear to be more useful for the purpose. The average line drawn on these bases is taken as the external boundary of the hinterland of Visakhapatnam port, and thus northern districts of Andhra, Southern districts of Orissa and M.P. and north-eastern districts of Bombay may be included in its hinterland.

157. The Antiquity of Prayag (Allahabad).

R. L. DWIVEDI, Allahabad.

The present paper, while investigating into the antiquity of Allahabad, attempts to show the strong influence, exerted by Rivers on the growth and decay of towns in the past. Like Varanasi, Prayag is not a city of great antiquity. In myth and legend the earliest name of Prayag was Pratisthan, the capital of Pururavas. Later on, under the influence of the Rigvedic religion, it was renamed as Prayag. Pratisthan disappeared due to the erosive action of the Ganga, for, in the Valmiki Ramayan (1000 B.C.), in which Prayag finds its first mention, there are no indications of any urban settlement near the holy confluence, except the hermitage of Rishi Bharadwaj. On the basis of the Buddhist texts (mostly written in Pali) also, it can be said that there was no city named as Prayag in the early Buddhist times, i.e., about 600 B.C.

But according to Tod, Prayag was the most ancient city of the Rajputs which was visited by Megasthenes in the 4th Century B.C. The city of Prayag was definitely under the rule of Ashoka the Great. Moreover it was visited and described by the famous Chinese traveller, Hiuen Tsiang in the 7th Century A.D. It is, therefore, quite probable that the ancient city came into being, for the second time, in the latter half of the first millennium B.C.

The ancient city, so vividly described by Hiuen Tsiang, was not noticed by Alberuni, according to whom, Prayag denoted the Tree (Akshayavat) and not any city in the 11th century A.D. Cunningham is of opinion that the ancient city had already been deserted long before Alberuni's time. It has been shown in the paper

that half of the city was washed away by the rivers while the remaining half was deserted by its inhabitants out of fear. It was on the site of this old city that in the 16th century A.D., Mughal Emperor Akbar, commanded a fort to be built, refounded the present city close-by and rechristened it as Allahabad. Any way, the present city of Allahabad is, undoubtedly, built on the departed greatness of previous cities.

158. Evolution of Jaipur.

(Miss) VIMLA SAXENA, Varanasi.

Jaipur (26°55'N and 75°50'E), the largest city and the chief commercial centre and capital of Rajasthan is in many respects the finest modern Hindu city. Owing to its location, nature and topography, it has become the most important service centre in Rajasthan.

In selecting the site of Jaipur the defence played a prominent role. It occupies the broadest part of the long fork within the two branches of the Aravalli hills, i.e. Nahargarh and Amargarh. The city is not far from Amber, the old capital.

Being situated in the saddle, Jaipur is easily accessible to the fertile plain of the Ganges too.

Jaipur was founded as walled city by Sawai Jey-Singh in 1728, with the palace as its nucleus.

Nearly for two centuries the city growth remained confined within the city walls, and it was in 1931, that Sir Mirza Ismail provided for the expansion of the city beyond the walls, on a planned basis. Schemes for the slum clearances, improvement of roads and development of new residential colonies were chalked out and the city began to grow systematically. But with the merger of the state into the New Rajasthan State and concentration of the state capital functions in the city, the growth became more spectacular.

159. Bokaro—The Future Steel Town.

RAM PRABESHI SINGH, Patna.

Natural landscape of Bokaro is registering new chapters of cultural features with the implementation of Damodar Valley Project. Lying in the heartland of the Damodar Basin, Bokaro provides an ideal geographical location for the assembly of basic raw materials. Bokaro is located in the centre of rich coke reserve areas. East Bokaro seams themselves contain over 600 million tons of good coal. Rich ore of Jamda and Sasanda iron belt has been reserved for it. Coal wagons released from Rourkela and Jamshedpur can be utilised to carry ore from the iron belt to Bokaro bringing economy in the cost of transportation. Good quality limestone can be conveniently assembled from Birmitrapur, Shahabad, Palamau, Hazaribagh and Singhbhum. Considering the economy that might be effected in the utilisation of returning empty wagons, Bokaro can assemble rawmaterials at the lowest cost.

Of the three sites, Bokaro, Sindri and Jamshedpur, Bokaro is the westernmost and naturally can distribute finished steel products in Bihar, northern India and even Bombay very conveniently. The average freight cost per ton of steel in Bokaro is expected to be Rs. 28.00 as against Rs. 28.42 and Rs. 30.20 at Sindri and Durgapur.

The Damodar and its neighbouring feeders would provide water for the steel plant and its busy planned suburb with defined cultural morphology.

With the establishment of Hatia mother plant, Bokaro steel plant is drawing its outline. Its morphology will be patterned in response to the landforms. The focus of the town will be the factory, but its administrative and semi-technical offices would be located close to its main gate. Residential section with its local business core will grow. The town will be dotted with open parks, schools, recreation centres and clubs. In its advanced stage it would develop peripheral settlements. The preface of the story of steel town has been written but varied chapters of its evolution have to be written before its appendix is catalogued.

160. Factors that led to the Selection of Sakchi as the site for the Tata Steel Plant.

ASHOK KUMAR DUTT, Patna.

In the end of the 19th century, Jamsetjee Tata decided to start a steel plant in India. His spirit could not be cowed down in spite of the previous failures of other enterprisers.

His first effort was to establish the steel plant in C.P. with Lohara ore and Worora coal. Due to the antipathy of the then India Government the plan was dropped.

Second effort for establishing the steel plant was made with Dhalli-Rajhara ore in C.P., but due to lack of nearby coking coal and adequate water-supply this plan proved abortive.

Mr. Weld, engineer, appointed by the Tatas, suggested for Padampur beside Mahanadi, where limestone was found. On the intervention of P. N. Bose, who related about the huge iron-deposits of Mayurbhanj, the site was shifted to Sini (beside Sanjay river and Calcutta-Bombay railway line). It was near to both Jharia coal and Mayurbhanj ore. The site was abandoned because of the difficulty in the construction of dam and reservoir.

The final choice came for Sakchi, a couple of miles from the Kalimati (now Tatanagar) railway station on the suggestion of Mr. Weld. Sakchi was the best site amongst all others and the final selection was guided by (i) minimum transport cost in raw material assembly, (ii) suitable place for adequate water-supply and (iii) sticking to the Calcutta-Bombay main railway line.

161. The Remodelling of Son Canal System.

RAMESHWAR PRASAD SINHA, Gaya.

The Son, rising from the Slope of the Amerkantak Prabat of Maikal Range, flows for a distance of 426 miles to the east and then to the north. Its catchment area is 26,608 square miles. The gradient of the hilly tract is 20 to 50 feet per mile where as it slopes 9 feet per mile in the plain. The general maximum flood discharge ranges from 8 to 10 Lac cusecs, but the average discharge comes down 75,000 cusecs. The minimum discharge of water is recorded 600 cusecs in May and June. Some times the discharge figures comes down even 6,000 to 9,000 cusecs in the middle of the Monsoon period. It is also notorious for sudden rise and fall of water and causes heavy flood and shortage of water in canal.

"The Son Canal System" with various branches in Shahabad, Gaya and Patna districts, was completed in 1874. The canals radiate from Dehri Anicut on either side of the river. The Western Main Canal, having Arrah, Dumarown, Bihia, Buxar and Chausa branches, spreads like fingers in the middle portion of Shahabad. The Eastern Main Canal spreads its branches in the east and irrigates the area of

Gaya and Patna districts. This canal system is pretty old and is being remodelled on new technique according to the present requirements.

The Son Canal System is being remodelled by constructing a new "Barrage-cum-Road Bridge" 5 miles up stream from the Dehri Anicut. The average discharge of the Son will be increased 11,600 cusecs or 4,400 cusecs more than the present after the completion of Rihand Dam in U.P. The North Koel, having a total catchment area of 2,000 square miles will release more water for the Son Canals. Likewise the old canal system of the Son, these are an ancient modernised two main canals, a number of branch canals, a large number of distributaries, two power houses on the either sides of the river, Road, Bridge, and river training works.

The present maximum capacity of the Western Main Canal is 4,600 cusecs. It is estimated that about 300 cusecs more water is required to cover the shortage in existing irrigated area. It needs 1,750 cusecs more water. The ultimate head capacity of the Western Main Canal at the new barrage, will be 8,000 cusecs, by which 1.35 lac acres an additional land will be irrigated and will meet the shortage.

The maximum capacities of existing Eastern Main Canal is 2,600 cusecs. It is experienced that about 200 cusecs will be required to cover the shortage. It is also about 38,000 acres could be brought under irrigation in the area under command. The total head capacity of the Eastern Main land will be 3,600 cusecs and that will irrigate an additional area of 13,000 acres and will meet the shortage. This will be the new map of the area.

SECTION OF BOTANY

President :—DR. S. K. PANDE, D.Sc., F.N.I.

Abstracts

VIRUS

1. Peach mosaic, a new record of virus disease from Kumaon.

K. S. BHARGAVA, Gorakhpur and N. S. BISHT, Nainital.

A mosaic disease was noticed in Golden peach variety. The affected trees are profusely branched and show marked stunting. Leaves show typical mosaic symptoms but there is no colour break in flowers. The disease is readily transmissible to other peach varieties and red nectarine.

2. *Nicotiana rustica* and *Cyphomandra betacea* —two natural hosts of Cucumber mosaic virus.

K. S. BHARGAVA, Gorakhpur and R. D. Joshi, Nainital

Nicotiana rustica and *Cyphomandra betacea* have been found to harbour Cucumber mosaic virus which has a wide host range. These plants act as potential source of infection to other crops viz. cucumber, pumpkin, spinach, amaranthus, tomato and pepper from which this virus has been isolated.

3. A mosaic disease of vegetable marrow (*Cucurbita pepo* L.) in Uttar Pradesh.

K. S. BHARGAVA, Gorakhpur and R. D. Joshi, Nainital

A mosaic disease of vegetable marrow due to water melon mosaic virus has been noticed. In addition, this virus is also seen infecting *Cyclanthera pedata* and *Cucurbita maxima* in nature.

The virus is readily transmitted by sap inoculation. It is also transmissible by *Aphis gossypii* and *Myzus persicae* and is of non-persistent type. Host range of the virus is limited to the plants belonging to cucurbitaceae. Serological tests indicate that it is different from typical cucumber mosaic virus.

Due to similarities in physical properties, host range and insect transmission, the casual agent of the disease is identified as a strain of water melon mosaic virus.

ALGAE

4. "A Study of *Camotylonemopsis lahorensis*"

D. C. PANDEY and A. K. MITRA, Allahabad.

Camotylonemopsis lahorensis (Ghose) Desikachary has been collected and cultured from the lawns of Botanical gardens, Allahabad University. It appeared in July as circular blue-green patches which later formed a woolly stratum. On agar

too an inoculum grows in a circular manner. Besides crescent-shaped filaments, other variations in shape are :—(a) only one end becomes erect. (b) one arm becomes much longer than the other and (c) the horizontal part becomes much convoluted. Erect arms of adjacent filaments adhere in clamps. Length of the filament exceeds 1.25 mm. in nature and increases indefinitely in culture. Cells are longer in the horizontal part and smaller and torulose in the erect arms. The sheath projects a little beyond the species of trichome and may extend even up to 50μ in liquid culture. Although majority of filaments both in the natural and cultural conditions show the characteristics single nearly medium intercalary heterocyst yet two intercalary or two terminal or one terminal and the other intercalary heterocyst may be close together in the middle separated by biconcave disc of intercellular substance. On agar and in liquid culture the filaments show considerable branching. The frequency of single pseudo-branching is more and arise frequently at the base of a terminal heterocyst. Hormogones from two-celled to about 20 cells in length have been found. They arrange themselves along the course of flow of rain-water, develop sheath and appear to have filaments arranged parallel which condition is not so marked in culture. Akinetes develop in old filaments usually in a series both in nature and culture.

5. Some Myxophyceae of Raipur District.

N. C. VERMA and M. C. SAXENA, Raipur.

Although Raipur District has innumerable ponds and tanks and water courses to harbour inexhaustible treasure of fresh water algae, there is no record of these plants at present. During the year 1958-59 the authors made a fairly rich collection of Algae in this region. The investigation of these algae is in progress and they will be recorded in a series of papers. The present communication deals with twentyone forms of Maxophyceae.

Situation and climate of the District has been described.

Systematic position and description of the species have been given.

The following is the list of species :

Order: Chroococcales.

Family : Chroococcaceae.

1. *Microcystis flos-aquae* (Wittr) Kirchn.
2. *Aphanocapsa benaresensis* Bharadwaja.
3. *Aphanotheca pallida* (Kutz) Rabenh.
4. *Aphanotheca bullosa* (Menegh) Rabenh.
5. *Gleocapsa atrata* (Turp.) Kutz.

Order: Nostocales.

Family : Oscillatoriaceae.

6. *Spirulina major* (Kutz).
7. *Lyngbya majascula* Harvey, var. *Chakiaence* Rao C.
8. *Lyngbya aerigineo-coerulca* (Kutz) Gom.
9. *Phormidium bohneri* Schmidle forma Rao.
10. *Phormidium purpurascens* (Kutz) Gom.
11. *Phormidium retzii* (Ag.) Gom.
12. *Oscillatoria tenuis* (Ag.).
13. *Oscillatoria curviceps* Ag.
14. *Oscillatoria variabilis* Rao.
15. *Oscillatoria formosa* Bory.

Family : Nostocaceae.

16. *Anabaena spherica* Born et Flah. var. *Attenuata* Bharadwaja.
17. *Nostoc spongiaeforme* Ag.
18. *Nostoc carneum* Ag.

Family : Rivulariaceae.

19. *Calothrix scytonemicola* Tilden.
20. *Calothrix fusca* Born. et Flah.
21. *Gleotrichia raciborskii* Woloszyne.

6. A Colonial *Cosmarium* from Nainital, U.P.

K. P. SINGH, Nainital.

A clonal *Cosmarium* was collected in October, 1957, from Sadiyatal in Nainital District. It was growing in association with species of *Oedogonium*, *Oscillatoria* and diatoms. The Observations were made from both living as well as preserved materials.

The colonies are usually spherical, rarely subspherical. Each colony usually contains four *Cosmarium*-like cells, but some colonies with eight cells are also occasionally met with. The cells are mostly circular in outline and measure 30.4—34.2 μ long and 20.9—24.3 μ broad. Cell surface is smooth without any ornamentation. Isthmus narrow and measures 5.1—6.8 μ . To the best of the writers informations the present record is the first report of the occurrence of a colonial *Cosmarium* in India.

7. Preliminary report on a New Species of *Chlorogonium* from Nainital.

K. P. SINGH, Nainital.

An interesting form of *Chlorogonium* was collected from a pool in Nainital. It appears in May and flourishes well during summer months and disappears suddenly in early July. It grows almost in an unialgal culture except with a few isolated cells of an *Euglena* species. The alga was collected periodically and was examined in living condition.

Vegetative cells are fusiform with two anteriorly inserted flagella. Cells measure 51.0—59.5 μ long and 6.8—10.2 μ broad. Each cell contains a parietal diffused chloroplast with 4-5 pyrenoids arranged in a median row. It reproduces asexually by four zoospores. Sexual reproduction is anisogamous and occurs by lateral conjugation of biflagellated male and female gametes. Female gametes are about 2-3 times bigger than those of male ones. Quadriflagellate zygote moves about for some time and then comes to rest, loses its flagella and becomes spherical and secretes a wall. Zygote on germination produces four zoospores.

Nainital alga resembles with *Chlorogonium elongatum* in shape of the cell, in presence of two anterior contractile vacuoles, but differs from the same in being slightly bigger, in having more than two pyrenoids and in exhibiting anisogamous sexual reproduction. It approaches *Chlorogonium euechlorum* in being anisogamous, but differs from it in presence of a fewer pyrenoids in a median row and in possessing only two contractile vacuoles at the anterior end. In view of the facts stated above Nainital alga appears to be a new species of Genus *Chlorogonium*.

8. Additions to the Marine Diatoms of the West Coast of India.

J. N. MISRA and C. S. SINGH, Varanasi.

This paper deals with the systematic account of the eight species of Diatoms collected from Dwarka (Saurashtra), on the West Coast of India. The species *Synedra crystallina* (Ag.) Kutzing, *Rhabdonema adriaticum* Kutzing, *Climacosphenia moniligera* Ehrenberg, *Eunotia lunaris* (Ehr.) Grunow, *Rhoicosphenia curvata* (Kutz.) Grunow, *Diploncis subovalis* Cleve are being reported for the first time from Indian Marine waters ; *Eunotia sudetica* O Mullar, and *Mastogloia exigua* Lewis were not reported so far from the West Coast of India. All the eight species are being added to the littoral marine Diatom flora of the West Coast of India.

9. Effect of Colchicine on the germlings of *Cladophora fracta normalis* (Raben).

J. P. SINHA, Patna.

The paper deals with the effects of colchicine on the germlings of *Cladophora fracta* Var. *normalis*. The zoospore germlings were treated with colchicine made up in culture solutions of 0.5%, 1% and 2% for periods of 12 and 24 hours in each concentration. A part of the treated material was then fixed in aceto-alcohol (1:1) while another part was washed thoroughly with distilled water and then transferred to culture vessels and allowed to grow. From the treated materials, which flourished well in culture, fixations were again made after four weeks to observe any persistent effect of colchicine. Permanent squash preparations of materials were made in acetocarmine for cytological studies.

In the samples fixed immediately, lethal effects were observed in 2% concentration. This material did not survive when transferred to the culture and died after four days. Samples treated with 0.5% and 1% concentrations, however, flourished well when transferred to the culture but mitosis was found to be arrested.

In samples treated with 0.5% solutions for periods of 12 and 24 hours and fixed after four weeks, all stages of mitotic divisions were found to be normal except that the chromosomes appeared to be slightly contracted. The contraction did not produce any effect on nuclear division.

In the samples treated with 1% solution for 12 hours and fixed after four weeks, nuclear divisions were found to be normal. Colchicine appeared to be comparatively more effective in samples treated for 24 hours. Few normal anaphases were observed in this case with normal chromosome number ($2n=24$). In only few cases duplication of chromosomes was observed. The number of chromosomes in these cases was estimated as upto 44—in all probability 48. The chromosomes appeared much smaller in size than the chromosomes of untreated materials.

Treatment with 1% colchicine for 24 hours was thus found to be more effective in bringing about duplication of the number of chromosomes while the lower concentrations were less effective.

FUNGI AND PLANT DISEASES**10. Two more species of *Tylostoma* from Orissa.**

B. PADHI, Cuttack.

Collections were made of the sporocarps of a species of *Tylostoma* Pers. from very wet soil on the edge of a compost heap at Cuttack in the first week of July. At about the same time another batch of sporocarps of the same genus was collected

from a nearby sandy foot-ball field. Examination shows that the collections constitute two widely differing communities.

The stipitate sporocarps of the first collection are completely epigeal gregarious, brown in colour, the stipes being 22-40-1-60 mm. long often curved and 2-3-4-5 mm. thick and the peridia being globose, 13-17-2-25 mm. in diameter and 10-13-1-20 mm. in height with apical pore and basal groove.

In the second collection, however, the peridium alone is often epigeal. The sporocarps grow isolated and are white in colour. The stipes are straight 7-16-3-29 mm. long and 1-1-7-2 mm. thick. The peridia are globoid 5-8-4-14 mm. in diameter and 4-7-0-10 mm. in height with the basal groove and apical pore on a papilla. Around the basal groove a ring like band gives reinforcement to the exoperidium.

The two communities also differ from the only one so far reported (Proc. Ind. Sc. Cong. Abstracts, p. 279, 1958) from this part of the country. The specific names of the three would be published later.

11. The Helotiaceae of the Mussoorie Hills—III.

K. S. THIND and PRITAM SINGH, Amritsar.

Four new species of Helotiaceae collected from the Mussoorie Hills during the monsoon months of 1956-57 are described in this paper. These are characterized as follows: 1. *Helotium* (sp. nov.) marked by gregarious to densely congested, cream to light yellow stipitate apothecia. It comes close to *H. salicellum* Fries but its spores are nonseptate and much smaller. Its apothecia, stipes and asci are also much shorter. 2. *Belonioscypha* (sp. nov.) which comes near to *B. miniata* Kanouse but possesses smooth and larger apothecia and much larger, 1-3 septate ascospores. 3. *Pocillum* (sp. nov.) which is characteristically confined to the petioles of dead leaves of *Quercus incana* Roxb. according to our observations of two years. In its morphology as well, it differs from the reported species of *Pocillum*. 4. *Phaeohelotium* (sp. nov.) characterized by nonseptate, and beaked ascospores, which easily differentiate it from its close relative *P. flavum* Kanouse, besides other morphological differences.

12. The Pezizaceae of the Mussoorie Hills—VIII.

K. S. THIND and PRITAM SINGH, Amritsar.

This paper deals with three more new species of Pezizaceae collected from the Mussoorie Hills during 1956-57. Their chief diagnostic features are as follows:— 1. *Humarina* (sp. nov.) which comes close to *H. leucoloma* (Hedw.) Seaver but differs from it in larger apothecia which are often split, smaller asci and ascospores, and paraphyses not enlarged at the top. It is also allied to *H. semimorsa* (Karst.) Seaver but is not that species. 2. *Humaria* (sp. nov.) which is marked by small, orange—red, hairy apothecia, clavate paraphyses and subglobose to ovoid, verrucose and multiguttulate ascospores. It comes close to *H. cubensis* (Berk. & Curt.) Thind and Sethi. 3. *Humaria* (sp. nov.) is characterized by yellowish orange and setose apothecia occurring on dead foliage of *Cupressus* sp., and 4-spored asci. The asci and the large broadly ellipsoid ascospores are both thick-walled.

13. The Clavariaceae of the Mussoorie Hills—XI.

K. S. THIND and G. S. RASWAN, Amritsar.

This paper deals with three more new species of Clavarias collected during 1956-57 from the Mussoorie Hills. Their outstanding characteristics are:—1. *Rama-*

ria (sp. nov.) which is allied to *R. formosa* (Fr.) Quél. but differs in the lack of yellow tips and chalky friable flesh on drying. It is also allied to *R. suecica* (Fr.) Donk but does not possess brush-like mat of pointed tips and chalky friable flesh on drying. It is not *R. subbotrytis* (Coker) Corner since it lacks such intense colour of the latter apart from other differences. 2. *Ramaria* (sp. nov.) which is easily differentiated from its close relative *R. mairei* Donk by the absence of trunk, thickening hymenium, absence of clamps and smaller spores. The subhymenium in this Mussoorie fungus is quite distinctive. 3. *Pistillaria* (sp. nov.) is characterized by white, very gelatinous, globose fructifications. Its stipe appears to extend characteristically into the head like a columella.

14. The Myxomycetes of India—XV.

K. S. THIND and M. S. Manocha, Amritsar.

This paper deals with three new species of Myxomycetes collected from the Mussoorie Hills during the monsoon months of 1955-56. Their outstanding characteristics are : 1. *Physarina echinospora* sp. nov. which is apparently quite different from *P. echinocephala* von Hohnel. The latter is reported to have spores nearly smooth while in the Mussoorie fungus the spores are very prominently verrucose, warts being predominantly 1μ long. Besides the spores of the Mussoorie collection are much bigger being $11.2-14\mu$ against $7-9\mu$ as reported for *P. echinocephala*. The peridium is single in the Mussoorie collection and not double as reported for the species. It is felt that the Mussoorie collection is a new species of the genus and the specific name *P. echinospora* is proposed on the basis of spine-like marking of its spores. 2. *Physarum* (sp. nov.) characterized by grey to greyish yellow, sessile, globose sporangia ; nodes of capillitium large, yellow but fading with age ; pale lilaceous, globose, minutely punctate spores, mostly $7-8\mu$ in diameter. It comes near *P. luteolum* Peck but apparently is not that species. 3. *Diderma* (sp. nov.) which comes near *D. simplex* (Schroet) G. Lister but differs from it in several respects. Its sporangia are smaller and uniformly dusty brown. Its columella is very prominent, calcareous and without any space between the bottom and the hypothallus. It possesses abundant and violet brown capillitium while its spores are violet brown and predominantly ovoid.

15. A new species of *Chaetomium* from soil.

R. S. DWIVEDI, Varanasi.

This paper deals with a new species of *Chaetomium* isolated from soil from a grass plot in Varanasi. The species is characterised by the production of small, sub-globose, brown perithecia with thin and only a few basal rhizoids ; smooth, septate, brownish, arcuate, terminal hairs, with simple tips. The lateral hairs are simple, light brownish, septate and pointed at the apex. Ascospores are subglobose, apiculate at both ends, light-olivaceous and $7.2-9.0 \times 5.4-6.3\mu$.

The arcuate hairs with simple tips, subglobose smaller ascospores distinguish this from *C. aureum* in which terminal hairs are arcuate with straight, incurved or once recurved tips and ellipsoid, flattened ascospores ; from *C. trilaterale* in which terminal arcuate hairs have coiled tips and ascospores are comparatively broader ; from *C. turgidopilosum* which has inflated terminal hairs with once recurved tips and lemon-shaped ascospores ; from *C. fusiformae* in which the tips of the hairs and ascospores are circinate and fusiform respectively.

Depending on the above mentioned facts it is concluded that the fungus in question cannot be assigned to any of the described species with terminal arcuate hairs. Therefore, it is considered to be sufficiently distinct to merit specific rank.

16. A new ascigerous fungus from soil.

R. S. DWIVEDI, Varanasi.

This fungus was isolated from soil at the depths of 7-12". It produces floccose, aerial, white, septate hyphae on several synthetic solid media such as Waksman's, Czapek's, Potato-dextrose and peptone-dextrose agar. Two gametangial branches arising from the same hypha or from two different hyphae, coil round each other and at the tip of the coil a globose ascus is formed. Variations in the appearance of gametangial coil were also observed. The asci are borne separately which bear eight globose ascospores which are hyaline, smooth walled in young stage; deep brown with prominent straight or curved tubercles on the wall at maturity. Each ascospore, when mature, is characterised by presence of a light-yellowish equatorial sheath. Asci vary from $30.6-36.0\mu$ and ascospores are $10.8-12.6\mu$ (excluding sheath) in diameter.

According to the character described above the fungus seems to be a member of the Endomycetaceae in the order Gymnascales but it has not been possible as yet to determine whether it deserves a new generic or a new specific status.

17. Additions to the records of Indian soil fungi.

R. S. DWIVEDI, Varanasi.

This paper deals with the following new records of fungi in India, occurring in soils of different grass plots in Banaras. The areas, from where soil samples were collected, were studied from the point of view of recording surface vegetation, soil texture, topography. The physico-chemical characters of the soil samples have also been determined. Several species have been isolated. Among them *Chaetomium funicola* Cooke, *C. botrychodes* Zopf, *Penicillium raistrickii* Smith, *Cephalosporium coramioides* Raillo *Gleocladium fimbriatum* Gilman and Abbott, *Fusarium chlamydosporum* Wollenweber and Reinking, *Myrothecium verrucaria* Ditmar ex Fr., *Phialophora richardsiae* (Nannf) Conant, *Hendersonula toruloidea* Nattrass, *Calcarisporium* sp., *Stachybotrys* sp., and *Caldariomyces* sp. have been recorded and described for the first time from Indian soil. *Stachybotrys* sp. differs from the previously described species of the genus in bearing larger conidia ($18-27 \times 7.2-12.6 \mu$).

The characteristic features of *Caldariomyces* sp. are the formation of synnemata ($90-560 \times 14.4-18\mu$), globose heads at the tip of synnemata and proliferation of head into one or two secondary synnemata after the spores are shed off. The spores are subglobose, 2-guttulate, brown with greenish tinge, $5.4-10.8 \times 3.6-4.5\mu$. A sub-culture of this fungus was sent to Commonwealth Mycological Institute, Kew, and it has been identified a species of *Caldariomyces*.

The further studies on the last three isolated are still in progress and the specific names will be published later on.

18. A new Genus of Plectascales from soil.

R. S. DWIVEDI, Varanasi.

In this paper an interesting fungus, hitherto unreported, has been described. The fungus was isolated from soil from a grassplot in Varanasi. It is characterised by production of the white, aerial tufts of septate hyphae and pattern of formation of conidia. The tips of the conidiophores swell in triangular form on which 2-4

sterigmatoid structures arise. Conidia borne in chain on the tips of these sterigmatoid structures in basipetal succession. Sometimes tips of the hyphae bifurcate and conidia formed on the branches in the aforesaid manner. Frequently conidial formation directly at the tips of hyphae without triangular swelling or bifurcation of the tips. Conidia globose, smooth walled, hyaline up to 13μ in diameter; perithecia white with slight yellowish tinge, surrounded by tufts of vegetative hyphae; asci hyaline, globose, 8-spored; ascospores globose to subglobose, hyaline, furrowed with two equational ridges.

The fungus differs markedly from the so far described genera of the order in the aforesaid characters and as the characters merit generic importance, the fungus is given a new generic status. The name *Royella albida* gen. et sp. nov. is proposed for the fungus.

19. Fungi isolated from Cuttack soil.

G. R. GHOSH, Cuttack.

This paper reports ten fungi isolated from different soil samples as stated below. Each sample was collected from a depth of 6 to 7 inches and its pH was recorded. Out of the ten isolates studied five are new additions to Indian soil fungi of which the *Nasoniella* sp. is believed to be a new one. So far only one species *M. grisea* (Smith) Smith has been described. The present one differs from *M. grisea* (Smith) Smith in having larger phialides swollen at the base and tapering gradually at the apex (7.2 to 9.6×1.8 to 2.4μ). They are sessile, solitary and irregularly borne by the hyphae along its entire length. The conidia are one celled dark much larger oval to pyriform, thick walled and minutely spinulose and borne in chains (4.8×6 to 7.2μ).

Soil Sample			Fungi isolated.	Remarks.
Source.	Texture.	pH.		
1. Kathujuri river bank, near the water level.	Sandy loam.	6.72	1. <i>Aspergillus flavus</i> Link. 2. <i>Aspergillus sydwi</i> (B & S) Thom & Church. 3. <i>Stemphylium macrospori deum</i> Berkeley & Broome.	New record in India.
2. Taldanda Canal bank near the water level.	Black clayey.	6.77	4. <i>Aspergillus awamori</i> Naka zawa. 5. <i>Penicillium aurantiovirens</i> . Riourge.	do. do.
3. Dry river bed of Mahanadi.	Sandy loam.	6.9	6. <i>Penicillium steckii</i> Zaleski. 7. <i>Nasoniella</i> sp. nov. 8. <i>Penicillium citrinum</i> . Thom. 9. <i>Aspergillus flavipes</i> Bainier & Sartory. 10. <i>Aspergillus wenti</i> Wehmer.	do. do. do. do.

20. Gymnoascaceae from Orissa.

GOURI RANI GHOSH, Cuttack.

Two *Gymnoascus* species and one *Pseudoarachniotus* sp. isolated from dungs of Guinea pig and Rabbit, are described here. The species identification is under study and will be reported in future.

Gymnoascus Sp. (No. 1).

Cleistothecia—Globose, 270—410 μ in diameter, reddish brown and heavy sporing.

Peridial hyphae—2.6 μ in diameter, smooth and thick walled, septate reddish brown. Peridial appendages often divided terminally into two short slightly curved branches, small blunt spines are frequently present along the length of the peridial hyphae.

Acid—Ovoid to spherical, 21.7 \times 27.9 μ , wall soon disintegrating and spores remaining in a ball of 8.

Ascospores—Smooth, thickwalled, reddish brown and elliptical, 6.8—7.5 μ \times 5.0—5.6 μ .

Gymnoascus Sp. (No. 2)

Cleistothecia.—Citron yellow at the beginning, turning yellowish brown at maturity, globose, 112—210 μ in diameter.

Peridial hyphae.—Smooth, thick walled, septate 4.4 μ in diameter. Golden yellow to yellowish brown in colour, forming a lattice work with wider blunt ends, small blunt spines present occasionally on the hyphae. Hyphae widening at the septa.

Asci.—Sub globose 22 \times 23.5 μ , 8 spored, wall soon disintegrating and spores remaining in a ball.

Ascospores—Smooth, thick walled, golden yellow, globose (5.0 μ in diameter) to elliptical, 4.4—5.5 \times 2.5—3.7 μ .

3. *Pseudoanachnolus* Sp.

Discrete cleistothecia lacking, peridial hyphae absent. Asci irregularly distributed in groups within the vegetative hyphae, 1.5—3.1 μ in diameter.

Asci.—Subglobose, 15.5—17.0 μ \times 17.0—18.6 μ hyaline, wall disintegrating soon leaving the spores in a ball of 8.

Ascospores.—Smooth, small light yellow, thin walled spherical (6.2—7.8 μ in diameter) to elliptical, 6.2—9.3 μ \times 6.2—7.7 μ .

21. *Phakopsora grewae* (Har. & Par.) Cummins, a new host for *Olpidium uredinis* (Lagerh.) Fischer.

MAHENDRA SHUKLA, Varanasi.

In this paper, *Olpidium uredinis* (Lagerh.) Fischer collected on an hitherto unreported host i.e. *Phakopsora grewae* (Har. & Par.) Cummins, has been described. This fungus is hyperparasitic within the uredospores of a few rust species, such as *uredo airae*, *Puccinia rahmni*, *Puccinia violae*, *P. rubrum*, *P. coronata*, *P. levis* and *Hemiteia canthii*. The affected uredospores become contentless, each of them contain minimum one, to maximum six, sporangia. Sporangia single celled, holocarpic, amoeboid, hyaline, ovate, spherical to subspherical, differ from hypnospores in having thin wall. In two cases exit tube was observed in the form of a papilla from the sporangium.

POLYPORACEAE

22. Some Fleshy Fungi of Raipur district.

M. C. SAXENA, Raipur.

Members of the fleshy fungi belong to some of the families of class Basidiomycetes and Ascomycetes. Raipur, having humid monsoonic climate, possesses a very rich flora of these fungi. Some of the members are very common. A good collection of these fleshy fungi has been made in the Department of Botany during June—September, 1959 and a report of the same will be published in a series of papers. The

present communication deals with some members of the family Polyporaceae. As far as the author is aware no work has yet been published on this subject from Chhattisgarh districts. The only work in this field, from Madhya Pradesh, is a short report of a few members of Polyporaceae from Sagar (Gupta, 1954).

Situation and climate of the place has been described.

Habit, habitat and detailed description of the members have been given.

The following is the list of species :—

Tribe Polyporaceae

- (1) *Trametes versatilis* Berk.
- (2) *Trametes serpens* Fr. (Poria)
- (3) *Trametes cingulata* Berk
- (4) *Hexagonia apiaria* Pers.
- (5) *Polyporus gilvus* Schwein.
- (6) *Polyporus gramocephalous* Berk.
- (7) *Polyporus sulphureus* (Bull.) Fr.
- (8) *Polyporus abietinus* (Dicks) Fries.
- (9) *Polyporus hirsutus* Fr.

Tribe—Fomitaceae

- (10) *Ganoderma applanatum* (Pers.) Pat.
- (11) *Fomes fastuosus* Lev.

Tribe—Daedaleaceae

- (12) *Daedalea flavida* Lev.
- (13) *Daedalea unicolor* (Bull.) Fr.
- (14) *Lenzites striata* Swartz.
- (15) *Lenzites betulina* Fr.

23. A new fungus on the leaflets of *Cycas resoluta*.

R. N. TANDON and K. S. BILGRAMI, Allahabad.

A species of *Teichospora* was recorded on the leaflets of *Cycas revoluta*. This appears to be a new species. So far no member of this genus has been reported from India.

24. The influence of carbon source on the amino acid composition of three pathogenic species of *Phyllosticta*.

R. N. TANDON and K. S. BILGRAMI, Allahabad.

Free and bound amino acid constituents of three species of *Phyllosticta*, viz., *P. carica-papayae* (Alesch), *P. morifolia* (Pass) and *P. mortoni* (Fair) were determined chromatographically. Aspartic acid, glutamic acid, alanine, arginine, valine and phenyl alanine were present in both free and bound form in all the three species. Serine and glycine were also present in every case except in *P. mortoni* where they could not be detected in free state. Lysine was present in *P. carica papayae* only. Proline and γ aminobutyric acid were absent in free and bound forms respectively in all the three cases. Alcoholic extracts of *P. carica papayae* and *P. morifolia* showed the presence of tyrosine which was absent in case of *P. mortoni*. Maximum quantity of amino acids were formed when glucose or sucrose were used as the carbon source. The amount of free amino acids showed an increase from the 5th to 15th day

25. Some physiological studies on *Pestalotia* sp causing leaf spot disease of *Livistona rotundifolia*.

R. N. TANDON and S. N. BHARGAVA, Allahabad.

I. An attempt was made to study the leaf spot disease of *Livistona rotundifolia* caused by *Pestalotia* sp.

II. The organism could grow and sporulate on a wide range of pH (viz. 1.5 to 10.2) but 6.1 was found to be most suitable.

III. Best growth and sporulation of the organism was recorded between 21°C to 27°C.

IV. The fungus was unable to grow in complete absence of carbon. Maximum growth of *Pestalotia* sp. was recorded when 50 gms. of glucose per litre was supplied. Sporulation decreased at higher concentrations of glucose. Sucrose was found to be the best source of carbon.

V. Growth of *Pestalotia* sp. increased with an increase in the quantity of potassium nitrate up to 9.0 gms. per litre but any further increase caused decreased growth. Sporulation was best between 5.0 to 9.0 gms. of potassium nitrate per litre.

Magnesium nitrate was best nitrogen source for the growth of this organism. Potassium nitrate and asparagine were best source for sporulation of the fungus.

VI. Nucleic acid was the best source of phosphorus for the growth and sporulation of this organism. Sporulation was equally good on potassium dihydrogen phosphate though the growth was inferior. Growth of *Pestalotia* sp. increased even when the concentration of potassium dihydrogen phosphate was increased up to 5.0 gms. per litre.

26. Grasses as Collateral Hosts of Rusts I. Susceptibility of certain grasses to *Puccinia Penniseti* Zimm.

G. G. DALELA and S. SINHA, Agra.

Grasses are known to serve as collateral hosts of many cereal rusts. It has been reported by Ramakrishnan & Sundaram (1956) that this rust infects *Pennisetum orientale* and *P. polystachyon* and these may act as collateral hosts. The possibility of the recurrence of the disease with the aid of a collateral host was explored by inoculating a number of grass species with the rust.

The grasses were raised in 4" pots (5-6 seedlings) and at 2-leaf stage the seedling were inoculated following the usual method of rust infection. Pots containing *bajra* seedlings were kept with each set to serve as control. The work was carried out in a spore proof glass house and all necessary precautions to avoid contamination were taken. Recording of reaction types was done 8-10 days after the incubation period using the reaction key of Vasudeva et al (1953).

It was found that *Pennisetum polystachyon* is susceptible. *Cenchrus ciliaris*, *C. setigerus* and *Pennisetum purpureum* got infected producing necrotic zones but without any pustules while *Dichanthium annulatus*, *Heteropogon contortus* and *Brachantha lata* showed chlorotic regions only. The other 13 grasses tested were immune to the rust.

27. Monoaecial Cup Culture Reactions in *Puccinia Penniseti* Zimm.

G. G. DALELA and S. SINHA, Agra.

The authors (1958 & 1959) tested 42 varieties of *bajra*, each with 10 samples of rust but no distinct differences in the infection types were noted. The rust reactions

were of 3 and 3—4 types following the reaction types in wheat rust. Since races are known to segregate at the time of hybridization it was considered desirable to test *bajra* varieties with monoaecial cup cultures of the rust samples.

Samples of rusts obtained from various localities were raised on Agra Local *bajra* variety which served as stock cultures. Teleutospores formed on these cultures were germinated in hanging drops and seedlings of *Solanum melongena* L. (the alternate host) were inoculated with the germinating teleutospores. On the appearance of the aecial cups but before their bursting they were picked up with a sterilized needle and each crushed separately a piece of butter paper. *Bajra* seedlings of Agra Local variety were inoculated with these aecidiospores and infections thus obtained were designated as monoaecial cup cultures. Eight varieties of *bajra* (improved and stable ecotypes) were inoculated with uredospores of these monoaecial cup cultures following the usual technique for rust infection and the rust reaction was noted 8—10 days after incubation period following the rust reaction key of Stakman & Levine for wheat rust.

Again 3 and 3—4 types of reactions were obtained indicating no hybridization in the study, although very slight differences were observed. Some varieties gave 3 type of reaction with the stock culture and 3—4 type of reaction with some of the monoaecial cup cultures and vice versa.

28. Chemical control experiments in *Puccinia Penniseti* Zimm.

G. G. DALELA, Agra.

Glass houses experimental trials were made to see if the results of germination studies (Dalela & Sinha, 1959) can be applied in controlling rust development. The effect of one representative of each group of chemicals, viz. sulpha-drugs, antibiotics, fungicides and synthetic phytohormones on the disease development was studied by spraying the foliar parts of host plants (24 hours before, 3—4 hours after and 24 hours after inoculation) and by supplying the chemical in the soil with the irrigation water.

The rust development was noted by counting the total number of pustules per leaf and the total number of pustules per unit area (1 sq. cm.). The data were analysed statistically following the simple 'analysis of variance' method.

Results revealed that spraying the plants with 2,4-D (10 ppm) 3—4 hours after inoculation or 24 hours after inoculation results in decrease of rust infection. Sulphadiazine (100 ppm) and streptomycin (1000 ppm) are effective when sprayed 3—4 hours after and 24 hours before or after inoculation. Spraying 3—4 hours after inoculation yields the best results. Coppesan (1000 ppm) is not effective. Soil applications of 2,4-D (10 ppm), sulphadiazine (100 ppm) and streptomycin (1000 ppm) does not net produce any results, which might be due to the failure of the uptake of the chemicals by the plants.

29. Evaluation of some recently introduced Fungicides in Uredospore germination in *Puccinia Penniseti* Zimm.

G. G. DALELA, Agra.

With a view to assess the efficacy of some recently introduced fungicides viz. Wetcot-15, Thiovit, Copper Sandoz, Ferenoxon, Micop-W-50 W.P., Cupramar, Tritisan, Kirti Copper, Yellow Curroicide and Flit-406, as possible spray materials for the rust of *bajra* (*Pennisetum typhoides* Stapf & Hubb.) caused by *Puccinia penniseti* Zimm., a detailed investigation on the effect of these fungicides on the uredos-

pore germination was carried out in the laboratory. The relative toxicity as well as the 'toxic' doses of the various fungicides were studied. The concentrations used in germination tests were 0, 10, 100 and 1000 ppm. Germination tests of uredospores were performed in hanging drop cultures kept at 14—15°C (optimum for germination) in a refrigerator. Fresh mature uredospores were taken for the studies to avoid age variations. Pyrex-glass-distilled water was used to prepare the various solutions and also served as control. 50 observations were recorded for each treatment. The data were subjected to statistical analysis following the 'analysis of variance' method on factorial basis.

The results indicate that the inhibition of spore germination, in general, shows a linear relationship with increase in concentration of the fungicide employed and the magnitude varied with the fungicide. On the basis of Trevan's suggestion (1927) that the concentration of a chemical giving 50% inhibition in spore germination can be considered as the toxic level, Flit 406 was 'toxic' at 100 ppm and Micop-W-50-W.P., Kirti Copper, Tritasan and Yellow Curroicide at 1000 ppm. No 'toxic' influence was observed of the remaining fungicides even at 1000 ppm.

30. Investigations on the Morphology and Life-history of Euphorbiaceous Rust, *Melampsora helioscopiae* (Pers.) Wint.

M. R. SIDDIQUI, Saugor.

Widespread uredial infection of the rust *Melampsora helioscopiae* (Pers.) Wint. has been observed in the first week of January on the young seedlings of *Euphorbia geniculata* Orteg. and *E. rothiana* Spreng. which appear as common weeds in the month of December.

The infection starts with the appearance of minute, scattered roundish or oblong, orange yellow uredial pustules on the leaves. The infection then spreads to all the green parts including inflorescence. Optimum germination of the urediospores was found to be at 16—18°C. Various experiments were conducted to test the viability of the urediospores and it was observed that at 24 hours exposure at 39—40°C and 9 hours exposure at 42—45°C killed all the spores.

Large number of cross inoculation tests were carried out and it has been established that the rust easily goes to *E. heterophylla*, *E. Pulcherrima*, *E. rothiana* and *E. dracunculoides*.

Late in the season uredia were followed by telia, which failed to germinate.

Uredial infection of the rust was observed on potted plants of *E. heterophylla* and *E. pulcherrima* kept in shade in the month of May. Full grown plants of *E. geniculata* showing only a few uredial pustules in the month of May were kept in the glass house under controlled conditions of temperature. The rust survived throughout the summer months on these plants. The probable mode of the survival of this rust has been worked out.

31. Fungi causing plant diseases at Jabalpur (Madhya Pradesh)—II.

G. P. AGARWAL, and R. BELIRAM, Jabalpur.

Agarwal, Nema and Beliram (1959) have initiated a series of papers on fungi causing plant diseases at Jabalpur and its suburbs. Series I describes some sixty-six parasitic fungi. The present paper describes five more deuteromycetous fungi occurring at Jabalpur. *Biharia smilacis*, a new species, on leaves of *Smilax macrophylla* Willd. has been described in detail. It differs from *Biharia vangeriae*, the only and the type species of *Biharia*, in the character of conidia, which are simple

and not branched as in the latter. The size of the conidia and conidiophores also varies in the two species. *B. smilactis* is the second species of *Biharla* being reported from India. The paper also includes *Septoria socia* Pass causing leaf blotch of *Chrysanthemum* sp., *Collectotrichum pithecolobi* Roldan on leaves of *Pithecolobium dulce* Benth, *Cercospora riachuelli* Speg. causing leaf spots of *Vitis trifolia* L., three new fungus records for India, and *Curvularia lunata* (Wakker) Boed. on leaves of *Musa paradisiaca* L. and *Cymbopogon citratus* Stapf., new host records.

32. Fungi causing plant diseases at Jabalpur (Madhya Pradesh)—III.

G. P. AGARWAL, Jabalpur.

Agarwal, Nema and Beliram (1959) and Agarwal and Beliram (1959) have described in the first two series of the paper seventy one parasitic fungi occurring at Jabalpur. The present paper describes five more parasitic deuteromycetes. It includes *Alternaria tenuis* Auct. on leaves of *Xanthium strumarium* L., *Ipomoea reptans* Poir., *Pisum sativum* L. and *Mimodica dioica* Roxb., the four new host records for *A. tenuis*, *Helminthosporium rostratum* Drechs. causing leaf spot of *Hiptage benghalensis* Kurz., a new host record; *Collectotrichum* sp. on leaves of *Calotropis gigantea* R. Br., a new host for *Collectotrichum*; *Gloeosporium artocarp* Delacr. on leaves of *Artocarpus integrifolia* L., a new record for the State and *Phyllosticta* sp. on leaves of *Tephrosia purpurea* Pers., a new host record.

33. Effect of Soil Temperature on Root-rot of Guar (*Cyamopsis psoraloides* (D.C.) and Wilt of Gram (*Cicer arietinum* L.) caused *Sclerotium rolfsii* Sacc.

S. B. MATHUR, Agra.

Influence of soil temperature on root-rot of guar and wilt of gram caused by *Sclerotium rolfsii* Sacc. and also on the determination of cardinal temperatures for the growth of the parasite was studied. Effect of soil temperatures viz. 20°, 25°, 30°, 34°, 38° and 42°C was conducted in soil temperature tanks designed after Wisconsin types. Experiments were performed in sand cultures irrigated with modified Shive nutrient solution. The fungus affects pre-emergence infection by inhibiting seed germination and also causes seedling mortality. In root-rot of guar the maximum pre-emergence infection was noted at 25° to 30°C while in wilt of gram 30°C alone was the most suitable temperature. In both the diseases increase in soil temperature from 20° to 30°C results in increase in percentage seedling mortality but further increase in temperature tends to depress the seedling mortality. The maximum seedling mortality was recorded at 30°C; 60.0% in wilt of gram and 52% in root-rot of guar. The linear mycelial growth of the parasite in culture was studied at different temperatures ranging from 15° to 42°C and maximum growth was obtained at 30°C.

Thus the total percentage seedling mortality in root-rot of guar and wilt of gram is maximum at 30°C which is also the optimum for the growth of the parasite, and the two diseases in reference are favoured by comparatively high soil temperatures.

34. pH effect on the Germination of Chlamydospores of *Protomyces macrosporus* Ung. causing 'Stem-gall' Disease of Coriander.

S. B. MATHUR, Agra.

Influence of varying Hydrogen-ion concentrations ranging from 4.6 to 9.2 was investigated on the inhibition of chlamydospore germination of *Protomyces*

macrosporus Ung. causing 'stem-gall' disease of coriander. The data was subjected to statistical analysis following 'analysis of variance' method. Inhibition of chlamydospore germination of varying extent was noticed at all the levels of pH under study. The least inhibition (21.4%) was obtained in pH 7.4. Any further increase or decrease in pH level tends to increase the percentage inhibition, more so in the acidic than in alkaline ranges. The percentage inhibitions were 94.1, 88.8, 48.7, 52.8, and 67.2 in pH 4.6, 5.6, 6.6, 8.4 and 9.2 respectively. Thus pH 7.4 is optimum for the germination of chlamydospores of the parasite. These results very well correspond with those obtained on the effect of soil pH on disease development which is also maximum in pH 7.4 (Mathur 1958). A possibility of a close association between chlamydospore germination and disease development in relation to pH is indicated.

35. Occurrence of Ascigerous Stages of Erysiphaceae in Bombay State.

S. D. PATIL AND T. S. MAHABALE, Poona.

'Powdery mildews' in their oidial stage are not uncommon and are of widespread occurrence in the tropical regions, but their ascigerous stages are not so frequently met with. This is mainly on account of the difficulty in accurate identification of the numerous tropical species belonging to this group which are known only in their imperfect or oidial forms. Consequently, dimensions and shapes of conidia (oidia), existence of host specialization in them have been largely used as the basic criteria for determining the species and then referring them to their respective form genera.

Butler and Bisby (1931) have listed 15 species of this family distributed over four genera in India. While giving the occurrence and distribution of the powdery mildews in India, they have stated that the powdery mildews are generally rare in the hotter parts of the world as compared to their numbers in temperate zones. So far as India is concerned, the distribution of powdery mildews is very wide, but in the hotter parts of this country they occur chiefly in oidial form only.

As regards the occurrence of these fungi in the Bombay State, previous works have shown that there are only six species of them comprising four genera viz. *Sphaerothecae*, *Erysiphe*, *Uncinula* and *Phyllactinia*. But their publications do not indicate whether the authors had observed only the perithecial or oidial forms of these fungi. Recently Chiddarwar (1956) had described one more species of *Erysiphe* on *Geniocalon glabrum* Cass.

The present paper gives comparative account of the morphology and systematics of the species of Erysiphaceae found in the perfect or ascigerous stage in 14 species. They were collected on 21 different host plants and belong to four genera of the Erysiphaceae. They were collected from different parts of the Bombay State.

36. Effect of Antibiotics on the growth of *Fusarium orthoceras* var. *Ciceri*.

S. K. CHAUHAN, Agra.

Experiments were conducted with four concentrations (25, 50, 75 and 100 p.p.m.) of five antibiotics (Ambramycin, Chloromycetin, Penicillin, Streptomycin and Terramycin) in relation to linear growth and dry matter of *Fusarium orthoceras* var. *ciceri* obtained from wilted plants of gram. Radial spread of the fungus was measured on Brown's standard agar medium, and for the dry weight it was

grown in Czapek's liquid medium. It was found that the antibiotic action was much more perceivable in liquid cultures than in the solid medium (In Ambromycin: 0.201 gm, 107 m.m. ; Chloromycetin: 0.200 gm, 105 m.m. ; Penicillin: 0.200 gm, 105 m.m. ; Streptomycin: 0.192 gm, 106 m.m. ; Terramycin: 0.201 gm, 98 m.m. and Control: 0.213 gm, 110 m.m.). The figures for radial growth do not show significant differences from the control thus supporting the suggestion of Muller (1958) that the antibiotics on the solid medium are adsorbed by the latter and therefore rendered ineffective. However, Terramycin seems to retard both the radial spread and the dry matter to the same extent.

37. Effect of Oil Cakes on Fusarium Wilt of Gram.

S. K. CHAUHAN, Agra.

Wilt of gram (*Cicer arietinum* Linn.) caused by *Fusarium orthoceras* var. *ciceri* App. & Wr. has been studied in relation to certain oil cakes amended soil. The experiment was planned to enable statistical analysis and interpretation of data. Six replications of pots, with ten plants in each, were maintained for each treatment both for the experimental set and the control so as to get sixty plants for observation. Three kinds of oil cakes: (i) mustard oil cake, (ii) til oil cake, and (iii) groundnut oil cake were used to manure the soil. 8 lbs. of garden soil was filled in each pot of experimental series. Half lb. of the finely ground oil cake powder was uniformly mixed with the soil in each treatment; one set of pots contained only garden soil for comparison. The soil of each pot was inoculated uniformly and ten seeds were sown in each pot.

When wilting started the mortality was recorded at regular intervals for each treatment in each pot separately. However, none of the plants wilted in the uninfested series (control). The figures for total mortality were analysed statistically and the effect of individual factor was found to be significant.

By the application of oil cakes there is a significant reduction in percentage mortality, the order of reduction being soil 63.33 < groundnut oil cake 20.00 < til oil cake 18.33 < mustard oil cake 8.33. There is no difference between the percentage mortality in til oil cake and groundnut oil cake the figures being 18.33 and 20.00 respectively (C.D. 3.995). In mustard oil cake it is significantly lower i.e. 8.33% ; while in the untreated soil the disease was quite high 63.33%.

38. Fungi from Hyderabad (India)—III.

P. N. RAO AND M. A. SALAM, Hyderabad.

In this paper, three species of the Fungi Imperfecti viz. *Colletotrichum gomphrenae*, *Colletotrichum calotropidis* and *Gloeosporium loranthei* parasitizing *Gomphrena decumbens* Jacq (Amarantaceae), *Calotropis gigantea* R. Br. Asclepiadaceae), and *Dendrothe falcata* (L.f.) Ettingh. (Loranthaceae) respectively, have been described and presented as new species.

39. Hyperparasites on Rust Fungi.

P. N. RAO AND M. A. SALAM, Hyderabad.

The paper deals with the study of three species of fungi imperfecti, viz. *Cercospora accidiicola* sp. nov., *Cercospora riveae* sp. nov., and *Cercospora cladosporioides* saccardo. hyperparasitizing the aecid cups of *Trochodinium sampathensis* Thirum, *Trochodinium ajrekari* Gharse, and *Aecidium oleae* P. Henn. respectively.

C. decidiicola on *Argyrea cymosa* Sweet (Convolvulaceae), *C. riveae* on *Riveae ornata* Choisy. (Convolvulaceae) are reported as new species while *C. cladosporioides* on *Olea dioica* Roxb. (Oleaceae), is a new record to India.

There seems to be no record of *Cercospora* spp. occurring as hyperparasites on rust fungi.

A study of the microtome sections of the diseased material revealed that the hyperparasitic infection had taken place on already rust infected leaves of the host plants. The infected aecial cups appeared dark and woolly, the aeciospores dry and shrivelled. Beyond this, no appreciable damage seemed to have occurred to the rust fungus.

40. Smuts of Hyderabad (Deccan)—I.

M. A. SALAM AND K. G. H. SETTY, Hyderabad-7.

With a view to survey the smut fungi from Hyderabad, a number of collections were made during the period 1953–59. In this paper and the papers to follow, it is proposed to describe and record the occurrence of smut fungi in the state which has not been taken up so far systematically except a few smut fungi which have been reported on some important cereals and millets by Syed Vaheeduddin (1955). In this paper 16 species of smut fungi occurring on various hosts are recorded, of which the following four marked with asterisks are reported as new hosts from India, i.e. *Themeda tremula* Hack., *Paspalum flavidium* A. Cam (Gramineae), *Cyperus corymbosus* Rottb., *Eleocharis acicularis* Vahl. (Cyperaceae).

41. *Corynespora cassicola* (Berk & Curt) Wei on *Carica papaya* L.

N. N. MOHANTY AND B. C. BEHERA, Bhubaneswar.

A severe leaf spot disease of Papaya (*Carica papaya* L.) caused by *Corynespora cassicola* (Berk & Curt) Wei was found to be widely prevalent in the State Agricultural Research Station, Bhubaneswar during August-September, 1958.

The infection starts with the appearance of minute white spots which gradually increase in size until they become angular or irregular in shape and 5-6 mm. in diameter. Each spot is surrounded by a yellowish halo. In case of severe infection, the affected leaves become chlorotic and wither.

The pathogen is characterised by simple, dark olivaceous brown, 2-14 septate conidiophores measuring $60-315 \times 6-9\mu$ and obclavate, brown, 3-15 septate conidia measuring $67.5-138 \times 9-18\mu$.

This appears to be the first record of the fungus causing serious leaf spot disease on Papaya from India.

42. Leaf spot disease of Black gram (*Phaseolus mungo* L.).

S. K. ADDY AND N. N. MOHANTY, Bhubaneswar.

A leaf spot disease on *Phaseolus mungo* L. caused by *Corynespora cassicola* (Berk & Curt) Wei was observed early in January 1959 in Bhubaneswar. It appears as minute reddish brown spots scattered all over the leaf surface, which gradually increase in size and assume a circular shape. The spots vary from 2-10 mm. in diameter. In cases of severe infections, affected leaves wither and shed.

The conidiophores of the fungus emerge singly through the epidermis on both surfaces of the leaf. They are simple, multiseptate, brown to dark brown and measure 100—160 x 7—10 μ . Conidia are terminal, borne singly, obclavate or cylindrical, olivaceous brown, multi-septate and measure 44-164 x 14-18 μ .

This is the first report of *Corynespora Cassicola* on *Phaseolus mungo* L. from India.

43. Influence of soil moisture on stem-rot disease of Coriander caused by *Sclerotinia sclerotiorum* (Lib.) Debary.

J. S. GUPTA, Agra.

Influence of four soil moisture levels viz. 10%, 15%, 20% and 25% on disease development of stem-rot of coriander caused by *Sclerotinia sclerotiorum* (Lib.) DeBary was studied under controlled conditions. Glazed tin-containers filled with garden soil were used and all the moisture levels on the oven dry-weight of the soil were maintained by following the weight method. Soil around each plant was infested with equal amount of fungal mycelium when plants were at 8-10 leaf stage. Observations were recorded on mortality rate as well as on total mortality.

The results indicate that total mortality of all the plants occurs under all levels of soil moisture ranging from 10-25%. Progressive increase in soil moisture level decreases the mean time taken for the complete collapse of the plants. It is also indicated that rate of collapse is higher from the very beginning under the condition of high soil moisture level. Thus it is evident that the disease is favoured by high soil moisture levels. Soursac (1922), in his studies on collar rot of lettuce caused by the same pathogen, also discovered the similar behaviour of the parasite.

44. Chromatographic Identification of Soluble Sugars in healthy and diseased leaves of *Coriandrum sativum* L. attacked by *Protomyces macrosporus* Ung.

J. S. GUPTA, Agra.

Extract of healthy and diseased leaves of *Coriandrum sativum* in 80% alcohol were tested for the presence of soluble sugars by descending filter paper chromatographic method. The chromatograms were developed in the upper layer of N-butanol-acetic acid—water mixture, dried at room temperature, sprayed with benzidine reagent and heated at 95-100°C. for 5-7 minutes.

Raffinose, sucrose, dextrose and fructose were detected in both healthy and diseased leaves, thus, indicating no influence of the disease on the pattern of free sugars, although there exists a great probability of their reduction quantitatively.

45. Antagonism Between *Rhizoctonia solani* Kühn and certain Soil Saprophytes : I A Laboratory Study.

K. B. DESHPANDE, Hyderabad.

Fawcett (1931) was the first to emphasise the use of known mixtures of organisms in plant disease investigations and to suggest that the development of many plant diseases may be very much influenced by associated organisms. It is

also recognised that although the success of the soil amendments or use of antibiotics in the control of plant diseases is being realised, the value in understanding empirically the antagonistic phenomenon under different conditions cannot be overlooked. Hence in this report the antagonism of saprophytic soil organisms like *Trichoderma viride*, *Penicillium clavariaeforme*, and *Chaetomium cochlioides* against *Rhizoctonia solani* under different conditions of temperature, pH, and nutrition has been described.

The antagonists *T. viride* & *C. cochlioides* were found more effective in the inhibition of the growth of *R. solani* at temperatures 25° and 20°C and this conforms to their growth-temperature relationship. *T. viride* was more effective in acid media as reported by others whereas other antagonists and especially *C. cochlioides* was more effective in the alkaline media. Hence suggestion is made that soil amendments increasing the activity of *C. cochlioides* might be a good control measure against the pathogen in alkaline soils.

The most interesting result of this investigation is the relative cellulolytic activity of the pathogen and the three antagonists. Contrary to the previous reports, the pathogen was found more cellulose-destroying than *T. viride* & *C. cochlioides* and this result was unaffected in spite of the case of NH_4Cl as the N. source.

46. Studies in Medical Mycology—IV. Nutritional Studies of Common Indian Dermatophytes.

S. N. DAS GUPTA and S. K. SHOME, Lucknow.

Nutritional requirements of some common Indian dermatophytes, i.e. *Trichophyton mentagrophytes*, *Trichophyton rubrum* and *Epidermophyton floccosum*, as to the effect of different carbon, nitrogen and vitamin sources, on their growth and sporulation were investigated. Out of the twelve carbohydrates (comprising of 8 mono-saccharides, 3 disaccharides and 1 tri-saccharide) tried, growth and sporulation was found to be best supported by *Glucose* and *Fructose* (Hexoses of mono-saccharide group) followed closely by *Sucrose* (di-saccharide). From among the various carbohydrates used, these strains were unable to utilise *Ribose* and *Rhamnose* among mono-saccharides, *Melizitose* (a tri-saccharide) and showed very poor growth in *Mannose* indicating difficulty in its assimilation.

Among the 24 inorganic, organic and combinations of nitrogen sources tried the strains failed to grow in any of the inorganic nitrogen sources. Of the organic sources complex forms like *Peptone* and *Casein hydrolysate* showed the best growth and sporulation. Out of the 14 amino acids tried in quantities of equivalent available nitrogen *Leucine*, *Arginine*, *Asparagine*, *Glycine*, *Alanine* and *Lysine* supported fairly good growth. The strains under study were unable to utilise *Tryptophane*, *Glutamic acid* and *Histidine*, the rest of the amino acids supporting moderate to poor growth. The various combinations of the amino acids tried always supported better growth than the individual amino acids but were never as good as the complex organic nitrogen sources. Among the six combinations tried, *Alanine*+*Arginine*+*Leucine* and *Leucine*+*Arginine*+*Asparagine* supported good growth.

None of the strains of the dermatophytes studied showed any deficiency for the ten vitamins viz., *Pyridoxine*, *Riboflavin*, *Thiamine*, *Nicotinic acid*, *Calcium-D-pantothenate*, *Paraamino benzoic acid*, *Ascorbic acid*, *Inositol*, *Choline chloride* and *Biotin*, tried in the present experiments. Although there was a general improvement in their growth in presence of the vitamins but nevertheless not any of the Vitamins used singly showed any definite stimulatory effect on the growth of these forms.

47. Studies in Medical Mycology—V. Ringworm of Scalp in Uttar Pradesh.

S. K. SHOME, Lucknow.

Ringworm of Scalp is a disease essentially of children, with a cosmopolitan distribution, although adults may also contract the disease. An account of the mycotic diseases of scalp, encountered by the author during the three years (1955-1957) survey of mycotic cases in Lucknow and suburban districts, studied in the Medical College, Lucknow, which may be taken as a standard figure for Uttar Pradesh (Das-Gupta and Shome 1959 and Gupta and Shome 1959) has been described. Only 20 cases (3.1%) out of the 620 cases of dermatomycoses studied were scalp infection (Gupta and Shome, 1959). The pathogens isolated from these cases were *Trichophyton tonsurans*, *Trichophyton rubrum* and *Candida albicans* out of which the latter two were responsible for two and one cases respectively, the majority of the infection being due to *Trichophyton tonsurans*. Certain interesting points during the studies were (i) The occurrence of disease among the inhabitants of plains, (ii) The complete absence of the pathogen *Microsporum audouinii* in culture and (iii) *Trichophyton rubrum* and *Candida albicans* as the etiological agents for mycotic infection of scalp which are new reports from India.

The symptoms of the disease are described along with the frequency of the different pathogens causing them.

48. Application of a Fungistatic substance produced by *Streptomyces griseus* (Krainsky Em. Waksman, et al) Waksman Agra strain on Potato Plants, its uptake and control of 'Early Bright' disease.

K. C. BASU CHAUDHARY, Agra.

The author (1959) reported production of a fungistatic substance by *Streptomyces griseus* (Krainsky em. Waksb. et al) Waksman Agra strain active against *Alternaria solani* in laboratory tests. Experiments were conducted to test whether this fungistatic substance can be taken up and translocated by potato plants as demonstrated in guttation drops and can prevent development of disease symptoms of 'early blight'. Potato plants were grown in sand cultures and irrigated with modified Knop's nutrient solution. Along with the nutrient solution the fungistatic substance was also applied to the plants. Guttation drops were collected after the application of the fungistatic substance which possessed inhibitory powers to show that the fungistatic substance was taken in by the roots and translocated upwards to the leaves. When such plants were artificially inoculated with spores of *Alternaria solani* the development of disease symptom was checked considerably.

In another experiment, where the fungistatic substance was used as leaf spray, it prevented the development of disease symptoms and was found to be more effective than coppesan, an organo-mercurial compound. The fungistatic substance is better as a spray than as a systemic chemotherapeutant as it has some toxic effect as shown by abnormal elongation of the internodes.

49. Physical properties of a Fungistatic substance produced by *Streptomyces griseus* (Krainsky Em. Waksman, et al) Waksman Agra strain.

K. C. BASU CHAUDHURY, Agra.

The author (1956) reported isolation of an *Actinomyces* antagonistic to *Alternaria solani* and *Helminthosporium oryzae* which has subsequently been identified as *Streptomyces griseus* (Krainsky em. Waksman, et al) Waksman Agra strain (Basu Chaudhary, 1959). In the present investigation experiments were conducted to

study the dilution end point, the thermal inactivation point and the duration of stability of the fungistatic substance produced by this strain in culture filtrate. It was observed that the fungistatic substance starts losing its activity when diluted with water more than 200 times and complete inactivation takes place when the dilution is raised to 1:1000. Similarly with the rise in temperature from 50°C. to 100°C. there is deterioration of the active substance. The thermal inactivation is not only related to temperature alone but it is also influenced by the duration for which it is exposed to a particular temperature, pH of the storing medium as also the aerobic and anaerobic conditions of storage govern the stability of the active substance. The activity is lost both in the high and lower ranges of the pH, but more rapidly in the acidic range than in the alkaline ones. The optimum pH for storage was found to 7.5. The fungistatic substance can be stored for 30 days at 5°C at pH 7.5 under anaerobic condition but under aerobic condition it deteriorates within 20 days.

50. Cultural study of *Polystictus xanthopus*.

A. C. SAHGAL, Naini Tal.

Sporophores of *Polystictus xanthopus* were found growing on stumps of *Quercus incana* and fallen twigs in Sat Tal forests. The cultural characteristics of the pathogen and its reaction on media containing gallic and tannic acids and gentian violet were studied.

Cultural characteristics—The fungus grows well on 2% malt agar. Growth moderately rapid, plates covered in 3-4 weeks when incubated at 25°C. Mat white, smooth, chamois-like, faintly zonate. Advancing zone 4-5 mm., even, raised, white woolly growth. Behind the advancing zone, the mat has a mealy appearance, is appressed and thick. Reverse, light straw colour. Reaction on gallic and tannic acids very strong. There is no discolouration of the medium in gentian violet.

Hyphal characters—Hyphae of advancing zone are hyaline, branched, nodose-septate. Fiber hyphae with narrow lumina also present. Fiber hyphae 2.1-4 μ in diameter, mostly 2.8 μ .

Aerial Mycelium: (a) Hyphae as in advancing zone, 1.4-3.3 μ in diameter, mostly 1.4 μ . (b) Fiber hyphae—walls of these hyphae thick and refractive, lumina narrow, branching scanty. *Submerged mycelium*—hyphae as in advancing zone but very much branched, nodose-septate, protoplasm much vacuolated.

51. Effect of Media on the Production of Antibiotics by Actinomycetes.

ASHALATA PAI, and P. NANDI, Calcutta.

With a view to increase the antibiotic potencies, the effect of various media on some antibiotic-producing actinomycetes obtained from soil, was studied. Actinomycetes were obtained from the soil samples by the usual dilution and plating methods; and tested for their antibiotic-producing properties by agar cross-streak and agar-cup methods of assay. The selection of test organisms was based on pathogenic types. 5 strains of actinomycetes showing both antibacterial and antifungal properties, were selected. These were grown in 12 different media at an optimum temperature of 28°C and daily assay of the culture broth was made from the 3rd to the 10th day of inoculation, against 4 human pathogenic bacteria and 4 plant pathogenic fungi; using the agar-cup method of assay. The assay media used were nutrient agar and Czapek-Dox agar.

It has been found that out of the 12 media used, only 4 were suitable for the production of antibiotics. Three of these 4 media contained soyabean meal, NaCl

and CaCO_3 in varying proportions with one or more of the following as sources of carbon—cornsteep (liquid), glucose, dextrin, curbay, glycerol—in variable quantities. The 4th medium contained straw infusion, peptone, glucose, Mg SO_4 , $\text{K}_2\text{H PO}_4$, NaCl and FeSO_4 . It was interesting to note that, while in some media, the antifungal activity was favoured in a few others the activity, both antibacterial and antifungal, was almost negligible.

52. The secretion of protopectinase enzyme and the growth of *Penicillium expansum* on natural media.

S. C. GUPTA, Nainital.

Decoctions of 20% potato tubers, 20% horse chestnut seeds (*Aesculus indica*), 20% oak seeds (*Quercus incana*), 10% lucerne seeds (*Medicago sativa*) and 2.5% tamarind seeds (*Tamarindus indica*) were prepared for comparing the growth of the mycelium and the secretion of protopectinase enzyme by *Penicillium expansum*.

The decoction of horse chestnut was found to be the best liquid culture medium for the growth of the fungus. The remaining four media were also found to be suitable for the growth of the fungus and could be arranged in the following order of preference : lucerne, tamarind, oak and potato. However, only lucerne and horse chestnut decoctions were found to be suitable media for the secretion of protopectinase enzyme by *Penicillium expansum*, the former medium being the best.

53. Apothecia formation of *Ascobolus* sp. in culture media.

KANTILAL CHAUDHURI and TIKARAM SHARMA, Calcutta.

Apothecia of *Ascobolus* sp. were collected from cowdung during the last monsoon in Calcutta and ascospores were harvested from the specimens. The spores were examined microscopically, centrifuged, treated with dilute NaOH solution and were washed and allowed to germinate in hanging drop cultures. The germinated spores were next grown in special media and development of apothecia were observed in 10 days. Monosporous cultures were then isolated and their sexuality tested. No formation of apothecia has been observed in any of the monosporous cultures. Further work is in progress.

54. Cultural studies of a broad-spectrum strain (A_{16} -444) of an antibiotic producing actinomycetes.

NARENDRA NATH SHIET and P. NANDI, Calcutta.

The Streptomyces strain A_{16} 444 was isolated after prolonged screening and its cultural characteristics were studied in detail. The strain was grown on twelve different media including some synthetic media. It grows well in CD medium with moderate antibiotic activity while antibiotic production is optimum in straw infusion medium. The culture was incubated at different temperatures from 25°C – 37°C for 7 days. It was observed that 28°C the production of antibiotic is maximum. The peak period of antibiotic production however, is between 6-8 days and the growth of the organism is proportional to the rise of titre.

The cultures were grown in shake and stationary flasks. The antibiotic spectrum is altered in the shake flasks where aeration of the media was continuous. The results show that antifungal activity increases in broths assayed from shake cultures. However, there is a general improvement of the antibiotic titre in cultures grown by continuous shaking.

55. Genetics of *Aspergillus niger*—Segregation and recombination from a heterozygous diploid.

A. K. MISHRA and P. NANDI, Calcutta.

A balanced heterokaryon (4 a lys+12 g iso) was obtained from two strains of *Aspergillus niger* (V₃₃) with different nutritional requirements and colour markers in conidia. The former strain is avellaneous in colour and requires lysine for growth whereas the latter is green and requires isoleucine for growth. From this heterokaryon between the two strains, a heterozygous diploid strain was isolated which had all the properties of the common parent (V₃₃). Segregation of the above diploid (4 a lys/12 g iso) is reported in the present study.

After plating nearly one thousand conidia of the diploid in complete medium colonies grew and showed new as well as original combinations. The recessive properties of the two parents viz. colonies showing avellaneous colour with lysine requirement or isoleucine requirements, green with lysine and isoleucine requirements and black with lysine, isoleucine and lysine and isoleucine requirements.

Segregation of recessive properties of the two parents from the heterozygous diploids seemed to occur by means of two different processes; somatic crossing-over and somatic reduction. In the first case the segregants retained their diploid state, carrying one or more (originally heterozygous) genes in the recessive homozygous state, the remainder being in their primitive heterozygous state. In the second case, the segregants carried haploid nuclei which perhaps contained chromosomes derived from two different strains.

56. Concentrations of Fungus spores in the air inside a cattle shed.

T. SREERAMULU, Waltair.

Although considerable amount of information on the nature of microorganisms present in the outdoor air is available, very little is known about the incidence of these in the indoor air. The existence of a characteristic air spora inside buildings has been reported by a few workers and for a better understanding of respiratory mycoses and allergic diseases of farmers and their cattle, the study of air spora of farm buildings is being taken up in recent years. To recognise the important components of the air spora inside cattle sheds in India, the air inside a cattle shed in the Government Dairy Farm near Visakhapatnam (Andhra Pradesh), was sampled from 5 to 30 January 1959, with a Hirst automatic volumetric spore trap kept with its orifice at a height of 1.5 metres above the ground level. Data for six groups of important components of the air spora collected during this preliminary study are presented in this paper.

Spores of *Cladosporium* and *Fusarium* which are known to grow as saprophytes on straw accounted for 48.3% and 27.0% of the total catch; Basidiospores and Mould spores (chiefly *Aspergilli*) contributing 8.3% and 3.2% respectively. Fragments of hyphae and all other fungus spores not included in the above named groups ("Others") contributed 3.4% and 9.8% respectively.

Day-to-day changes in the concentrations of these six components of the air spora and changes in their relative frequencies at different times in the day are given. Spores of *Fusarium* and Basidiospores occurred mostly during the night time with their daily maxima during the early hours of the morning. *Cladosporium* was an important component of the daytime air spora with its daily maximum during the middle of the day, while Mould spores, Hyphal fragments and the "Others" occurred during the afternoon, all showing their peaks at 18.00 hrs. To indicate the relative importance of these spore types and the maximal concentrations to which the cattle in the shed were exposed, the highest daily mean

concentration, the highest hourly concentration and the highest hourly mean concentration observed for each of the spore types during this period are also given.

These results have been discussed and in view of the fact that some of the air-borne spores are able to bring about abortions and some allergic reactions in cattle, it is suggested that an extensive study of the air spora of cattle sheds in India may be undertaken to determine the maximal concentrations of potential allergens occurring in the air inside these sheds. This knowledge together with the records of the reactions of farmers and their cattle is sure to yield useful information for the proper understanding of some of these respiratory mycoses and allergic disorders.

BACTERIA AND VIRUS

56A. The effect of potassium nutrition on multiplication of tobacco mosaic virus in Turkish tobacco (*Nicotiana tabacum* L.) plants.

G. S. VERMA and J. P. VERMA, Lucknow.

The effect of potassium nutrition on tobacco mosaic virus multiplication in Turkish tobacco (*Nicotiana tabacum* L.) plants was studied by supplying them with Arnon and Hoagland's nutrient solutions containing 3900, 390, 39 and 0 ppm. of potassium (KNO_3). Plants were grown in purified sand and inoculated with tobacco mosaic virus. Height, fresh weight and dry weight of healthy and diseased plants were recorded at 3 different intervals following inoculations. Virus concentration of juice was measured by local lesion count method on *Nicotiana glutinosa* L. plants. Optical density of partially purified virus fractions and total Kjeldahl-nitrogen in 1 ml. aliquots was also measured.

Plants responded differentially to different levels of K supply and virus infection. Fresh and dry weights of plants were affected more than the height of the plants after infection. The virus concentration as measured in expressed juice is affected by differences in K supply, by upsetting metabolic processes in plants.

BRYOPHYTA

57. On the epiphyllous liverworts from Agumbe and Mercara.

S. K. PANDE, Saugar and K. P. SRIVASTAVA, Lucknow.

This note deals with a taxonomic account of the epiphyllous liverworts of Agumbe (Western Ghats, Ca 2,500) and Mercara (Western Ghats, Ca 3,780'). Both the localities abound in this class of hepatics and about a dozen species have, so far, been identified from the former locality and nine from the latter. All the species are referable to the Acrogynae.

58. On a species of *Anthoceros* *A. satpurensis* Srivastava Sp. Nov.

K. P. SRIVASTAVA, Lucknow.

Anthoceros satpurensis grows in clusters on moist rocks often in association with *Phaeoceros communis* (St.) Schffn. et Pande. The thalli are dark green and firmly attached to the substratum. The epidermal cells are rectangular or polygonal, $28-40\mu \times 21.5-27.8\mu$, and each has a single large spherical chloroplast. The

involucres are generally single and more or less inflated below and cylindrical above. The stomata on the capsule wall are few and their guard cells are equal in size. At maturity the capsule dehisces by two perfect valves splitting up to the base and the valves do not twist on drying. The pseudoclater has strongly thickened wall and the thickenings show small irregular projections into the interior of the pseudoclater. The androecial chambers lie deeply sunk in the thallus and the body of the antheridium measures about $125\ \mu$ and is borne on stalk 3-4 cells high.

Plants dioecious, medium, prostrate, terrestrial or on rocks. *Thallus* 7-11 mm. long, 3-5 broad, cavernose, margin irregularly lobed, lobes small, rotundate or truncate. *Involucre* solitary, 3 mm. \times 7-1 mm., cavernose. *Capsule*, 8-12 mm. long, thin, sparingly stomatiferous. *Spore* dark, $32\text{-}34\ \mu$, micropapillate. *Pseudoclater* long, $360\ \mu$, vermiform, solid, dark, septate, 4-celled, walls thick. *Androecia* few, chamber large, polyandrous, aperture circular. *Antheridia* up to 20 in a chamber, large, oval.

59. Regeneration in *Atrichum* Palis.

R. S. CHOPRA and N. N. BHANDARI, Amritsar.

Experiments on regeneration in *Atrichum* Palis. were carried out in 1956 and 1957. During the first year no results were obtained but some points were made out during the second year. These plants have a remarkable capacity of regeneration and the same is increased if plants are exposed to dryness for a few days. Protonemata develop on detached leaves, stem and leaves when the whole plants are plated. Generally the protonema initials arise from two cells, one on either side of the lamellae, but some times these initials are produced from the cells of the lamellae, the lamina or even the lower epidermis of the nerve. The young protonemata may elongate, and branch profusely or may develop into parenchymatous masses. The buds arise laterally on the branched protonemata. The parenchymatous mass may develop a growing point and produce a new plant, or it may bear branched protonemata. A cell that is destined to produce the protonema, undergoes changes in its staining properties.

60. Vegetative reproduction and regeneration in South Indian Mosses I.

C. SRINIVASAN, Annamalainagar.

Ninety-five species of mosses of the Nilgiris Hills have been under investigation by me for sometime past in the Department of Botany of the Annamalai University. Out of these, seven species of mosses have been found to exhibit certain interesting modes of vegetative reproduction and regeneration. They have been described with illustrations in the fuller paper. However, a summary of the observations on them is appended below :

Vegetative reproduction : Under this sub-division the mode of vegetative reproduction is classifiable under two heads, e.g. (a) In *Campylopus nodiflorus* (C.M.) Jaeg. and *Brothiera leana* (Sull.) C. Mull leafy buds or bulbils are produced in the axils of leaves in the growing region of the gametophyte. (b) While in the following three mosses *Barbula indica* Brid., *Brachymenium exile* Bryol. and *Bryum argenteum* Linn. elongated and club-shaped multicellular gemmae are formed on a fleshy receptacle in the axils of leaves.

Regeneration : Whereas under this sub-division as well, the mode of regeneration is classifiable under two heads : e.g. (a) In *Barbula indica* Brid. triradiate or cross-like 'deciduous rhizopronemata' are formed at the tip of protonematal filaments when grown in petridishes and irrigated with tap water under natural

conditions without the addition of any herbicide. (b) While in *Leucobryum sculare* C. Mull regeneration of the mosses was observed by the production of rhizoids from the attached and detached leaf bases and leaf apices, profusely branched rhizoids are noticed to arise from the axis and the foot of the capsule in *Pleurobryopsis orientalis* (C.M.) Fleish.

61. On the anatomy of the axis of the South Indian Mosses.

C. SRINIVASAN, Annamalainagar.

About one hundred species of South Indian Mosses belonging to 68 genera and falling under twenty-seven families have been so far collected and their axes examined.

Based on the structure of the moss axis as seen in the transverse section they are grouped under ten heads such as :—I. Peripheral jacket of very thick-walled cells large central strands of thin-walled parenchyma-like cells. Example : *Barbula indica* and *Funaria sinuato-limbata*. II. Peripheral jacket of very thick-walled cells with narrow central strands of parenchyma like cells. Example : *Cyrtopus*. III. Peripheral jacket of very thick-walled cells with central strands of thickened cells. Example : *Plagiopus*. IV. Peripheral normal epidermis with parenchyma-like large central core of cells. Example : *Hookeria acutifolia* and *Distichophylla succulentum*. V. Peripheral jacket of very thick-walled cells and central narrow strands of parenchyma-like cells with a median thin-walled cells. Example : *Bryum argenteum*. VI. Peripheral jacket of very thick-walled cells and central narrow strands of thickened cells with a median thin-walled cells. Example : *Pogonatum neesii* and *Fissidens excedens*. VII. Peripheral normal epidermis and central narrow strands of thickened cells with a median thin-walled cells. Example : *Mnium coriaccum*. VIII. Peripheral thick-walled epidermis with a minute space from which radiate thin-walled cells of large central core. Example : *Erythrodontium julaceum* and *Trachypus bicolor*. IX. Peripheral jacket of thick-walled cells with a narrow cavity in the central core of thin-walled cells. Example : *Catharinaea aculeata* and *Breutelia sclerodictya*. X. Peripheral narrow epidermis and a central large cavity. Example : *Thysanomitrium umbellatum* and *Campylopus nodiflorus*.

Differential double and triple staining of the sections indicate the central core in different peculiar forms. It shows that it is made up of :—1. Very thick-walled lignified cells giving an appearance of an actinostele. 2. A parenchymatous pith either protected by an endodermis or not. 3. A centralmost cell or cavity surrounded by six to eight radiating thin-walled cells which merge with the rest of the cells of the central core. 4. Thin-walled cells which are disorganised resulting in the formation of a cavity. 5. A well established cavity or canal bound only by the epidermis to which the leaf bases are attached.

In most of the mosses a jacket of thick-walled cells constitute the peripheral region. They are yellowish brown and stained red by safranin. The outer layers are more and more thickened. The presence of this peripheral jacket is a matter of ecophysiological interest.

PTERIDOPHYTA

62. On a collection of ferns from Shevaroy Hills, Salem District, Madras State.

K. SUBRAMANYAM, K. THOTHATHRI and A. N. HENRY, Coimbatore.

The Shevaroyas are situated to the north-east of Salem town at a distance of 26 km., the main hill station being Yercaud. Two seasonal explorations were

made in the year 1958, and in all a total number of 51 species of ferns representing 14 families and 35 genera were collected.

In Shevaroy, the evergreen moist type of forest is characteristically seen where the vegetation is undisturbed and it is interesting to note that all the important fern families are represented here like Ophioglossaceae, Marattiaceae, Osmundaceae, Schizaceae, Gleicheniaceae, Hymenophyllaceae, Cyatheaceae and Polypodiaceae (*sensu lato*). Among the rare and interesting ferns mention may be made of: *Aneimia wightiana* Gard., *Antrophyum plantaginicum* Cav., *Athyrium macrocarpum* Bedd., *Botrychium daucifolium* Wall., *B. lanuginosum* Wall., *Cytomium falcatum* Presl., *Dryopteris cochleata* C. Chr., *Hymenophyllum exsertum* Wall., *Leptochilus decurrens* Bl., *Lindsaya heterophylla* Dry., *Lygodium scandens* Sw., *Niphobolus gardnerii* Mett., *Osmunda regalis* Linn., *Pteris cretica* Linn., *P. quadriaurita* Retz. var. *argentes* Bedd. and *Trichomanes proliferum* Bl.

The classification of Copeland is followed and the salient taxonomic features of the ferns collected are mentioned in the enumeration. Out of the plants listed Aspidiaceae is very well represented with the largest number of genera and species, the next in order being Pteridaceae and Polypodiaceae (*sensu stricto*). The collections include a number of species which are new distributions to Salem District.

63. Pteridophytes of the Eastern India—An enumeration of the species collected and their nomenclature.

G. PANIGRAHI, Shillong.

Inadequacy of knowledge on the systematics of the rich fern flora of India and the necessity to revise Beddome's Hand Book was stressed by Panigrahi. The botanical collections from the untrodden tracts of Assam, NEFA Agency, Bihar, Orissa and Tripura by the Eastern Circle of the Department of Botanical Survey during the last three years, have now yielded large collections of the Pteridophytes, mostly, ferns. Identification of these collections, representing 2500 field numbers, was attempted with the help of Central National Herbarium, Calcutta, where, however, the Pteridophytic herbarium is arranged and named after Hooker's *Species filicum*, naturally with nomenclature, completely obsolete at present.

This paper presents an enumerated list of 329 species of ferns and their allies from Eastern India with correct names determined with the help of all available literature on nomenclature, together with the synonyms. Materials which may necessitate new combinations and descriptions of new species are being scrutinised. It is, however, clear that Beddome's nomenclature on *Nephrodium*, *Diplazium*, *Pleopeltis* and *Polypodium* etc. are completely out of date and have now been suitably treated. *Microlepia speluncae* (L) Moore and *Pleopeltis linearis* Thunb to cite a few, appear to be species complexes and need further careful study. *Psilotum triquetrum* Sw. (Siam, NEFA), *Osmunda cinnamomea* L (Kameng NEFA), *Christensenia aesculifolia* (Bl.) Maxon (Assam), *Matteuccia orientalis* (Hook) Trev (Kameng NEFA) as also *Dipteris wallichiana* Br. (Kameng, NEFA) turn out to be restricted in distribution.

64. The Shoot Apex of Isoetes Sampathkumarani, Rao, L.N.

Miss USHA SHARMA, Lucknow.

Two different views have been expressed in the past regarding the shoot apex of *Isoetes*. One view is that it arises from a single apical cell. Another view is that a group of cells form the meristem of the shoot apex. It has been found

in *I. sampathkumaranii* that a group of cells differentiate into an outer epidermal layer dividing mostly by anticlinal walls and an inner mass of cells dividing irregularly. The entire tissue is the initial shoot apex in this species of *Isoetes*. A similar condition has also been noted in *I. coromandelina* (Bhambie, S., 1957. The shoot apex of *Isoetes coromandelina* L., J.I.B.S., 36, No. 4, pp. 492-502).

65. Studies in the Indian Hymenophyllaceae—Pt. I. Contributions to our knowledge of *Amphipterum* sp.

Miss USHA SHARMA, Lucknow.

The paper deals with the morphological and anatomical features of a South Indian species of *Amphipterum* collected from Mercara in Coorg. A detailed account is given of the leaf rhizome, sporangial initiation, spore formation and some cytological stages.

The rhizome, which is totally devoid of roots, has a centrarch protostele. The leaf trace is formed by the division of main stele into two, thus no leaf gaps are formed.

The leaf, which is highly lobed, has dichotomous venation, free veinlets and a lamina generally one cell thick except round the vascular bundles. Accessory wings are present—a feature which distinguishes *Amphipterum* from *Meringium*.

Dermal appendages are unicellular hairs with saccate base, which are found on the rhizome, and on the petiole wherever not covered by the lamina.

Involucre is of the valvate type, the valves having entire margin. The receptacle is cylindrical and slightly exerted. The sorus is gradate and basipetal in development. Sporangia are 207μ long, with oblique annulus of 20 to 22 cells, complete and opening by a transverse slit.

The development of the sporangium is of the leptosporangiate type and is initiated by a single cell. Spore mother cells are 16 in number and the spores' number is 60-64. Spores are tetrahedral in form and measure 26 to 30μ .

A fuller paper on the subject will be published elsewhere.

65(a). Apogamy in *Adiantum philippense* L. and its Cytology.

J. GHATAK, Calcutta.

Wild plants of *A. philippense sensu* Pichi-Sermolli from five localities included under three districts of West Bengal but growing under similar ecological niches, supplied the materials of the present investigation. Spores produced were broadly of two types: (a) large and regular, (b) small and irregular. After germination on sterilised soil the spores produced thin, cordate and symmetrical prothalli which showed only antheridia but no archegonia. In contrast to sexual ferns, apogamous sporophytes developed early from the bulbous outgrowths formed below the notches of the prothalli.

Mitotic squashes from root-tips of the sporophytes indicated the presence of 90 chromosomes. Meiosis was studied in two types of sporangia: 8-celled and 16-celled. The spore mother cells from 8-celled sporangia clearly demonstrated the presence of 90 pairs. This confirms the previous observation of Manton (1953) in material collected from Ceylon.

Chromosome pairing in the spore mother cells from the 16-celled sporangia has also been studied. 30 bivalents showing the formation of chiasma (which are absent from the 90 pairs of 8-celled sporangia) and 30 univalents were observed in the 16-celled sporangia. The nature of chromosome pairing suggests that at least one diploid and another tetraploid or apogamous diploid had been involved in the ancestry of this apogamous triploid form of *A. philippense* L. from W. Bengal.

The 8-celled sporangia were more numerous in comparison to the 16-celled ones. As a result the large, regular and viable spores produced in consequence of regular meiosis in 8-celled sporangia were more than the small irregular spores formed out of irregular meiosis in the 16-celled ones. This is in accord with similar results on other apogamous ferns (Döpp-1932, '39; Manton-1950; T. Walker-1956; J. Ghatak-1959).

GYMNOSPERMS

66. On the foliar sclereids of *Taxodium distichum*, Rich.

A. R. RAO and J. P. TEWARI, Lucknow.

The stem, leaves and cones of *Taxodium distichum*, Rich. were studied to find out the distribution and ontogeny of sclereids in them. The cones so far as we could see did not show any sclereids. In the stem the bast fibres are regarded ones that could be interpreted as sclereids. Since these bast fibres are regarded by some as not falling strictly within the category of sclereids, no further study was made of these. But it might be pointed out that these bast fibres occur in two sets. One set of fibres occurring in groups is produced early by the cambium and is pushed off with the periderm. A second set produced by the later cambial activity persists in the form of scattered thick walled fibres in and around the phloem.

In the leaf we do find sclereids but these occur at the margin of the leaf and run parallel to it. These sclereids are hypodermal in position, unbranched, septate in earlier stages with the inner surface of the wall being irregular. The sclereids do not reach the tip of the leaf but stop at a little distance from it. They may occur in rows or singly but are generally concentrated at the margins. Sections of very young leaves show that the sclereids are ontogenetically derived from the mesophyll. Their contents gradually disappear and the wall becomes thicker and the cells elongate. Longitudinal sections of the leaf show the sclereids running parallel to the epidermis but exceeding the epidermal cells in length and each has an elongated nucleus. We are inclined to think that the sclereids are metamorphosed mesophyll cells. These sclereids could be classed under the category, *Fusiform sclereids*.

ANGIOSPERMS

67. Abnormal position of cob in maize (*Zea Mais*).

SHIVDAYAL SAKSENA, Bhopal.

In a maize plant the female inflorescence has been found growing on the male inflorescence in place of one of its branches. The cob was naked (without awns and covering bracts). The grains (fruits) produced on the cob were perfect, and on sowing germinated well, but the plants produced from these seeds showed no abnormality.

68. A note on the occurrence of Staminal Corona in abnormal flowers of *Petunia hybrida* Vilm.

T. R. DUTT and N. K. CHAKRABORTY, Agartala.

During December 1955 a few flowers of *Petunia hybrida* Vilm. with a staminal corona of petal-like outgrowths were noticed. The outgrowths were continuous

with the connectives but laterally detached from apices of respective anthers. The single vascular trace of the connective bifurcated on entering the corona. The split halves ramified on each of the two lobes of the corona. The microsporangia were usual and contained mature pollen grains. Progenies raised from the abnormal flowers were normal. Possibilities of the teratological phenomenon being a mutation, variation or a reversion are discussed in the paper. Interpretation of the reversion on classical and modern concepts of stamen morphology are given.

69. A contribution to the study of air-space tissue in *Cyperus*.

A. P. MANI, Calcutta.

A critical study was made on the air space and diaphragms of twelve species of *Cyperus* collected from West Bengal with special reference to their development and function. The formation of lysigenous cavities in the aerial parts and in the roots has been found to be due to different causes. While in the aerial parts they are the result of rupture and death of the stellate cells formed by the rapid growth of the surrounding tissue, in the roots they have been indicated due to starvation and lack of oxygen, the latter being the main contributing factor. The air-space tissue of *Cyperus* does not seem to have any importance from the point of view of buoyancy, but the continuous system of large lacunae seems to afford sufficient room for oxygen-rich air to pass to the submerged regions of the plant.

Diaphragms which are perforated structures, one to several layers thick, interrupting air passages at intervals have been shown to occur in the leaf-bases of all the species under investigation and in the leaf-blade and inflorescence axes of more aquatic forms. They have been shown to occur with or without the association of cross-bundles. The main functions of diaphragms in *Cyperus*, as they appear, are to prevent the entrance of water into the cavities and aid in the circulation of air. Other functions which are generally associated with diaphragms are also discussed.

70. Growth of excised mature embryos of wheat in different media with varying concentration.

REAYAT KHAN, Aligarh and L. F. RANDOLPH, Ithaca, U.S.A.

Growth of excised mature embryos of *Triticum vulgare* var. Pb 591 was studied in five different media, viz., Knudson's Orchid Agar and the basic media of Rapaport, Randolph-Cox, Street and Nitsch. In the first three of these media and Knudson's C medium, comparisons were made with reference to the agar concentration of the media.

The root of wheat embryos in artificial culture seems to be more selective in its requirements than the shoot.

Comparisons of the same medium at 1% and 1.5% agar concentrations showed significant difference only in the case of Randolph-Cox medium. This medium at 1% agar concentration gave better root growth than at 1.5% but no significant difference was noted in the case of shoot growth.

When two different media were compared at 1% agar concentration, root growth invariably exhibited significant difference, one of the two media giving better result than the other. But when the same media were compared at 1.5% agar concentration, root growth exhibited significant difference in only one out of six cases. This may suggest that, in order to enable the finer distinctions between media to express themselves, the agar concentration of the medium should be kept low, as far as possible,

71. A contribution to the Embryology of Vacciniaceae.

J. VENKATESWARLU and H. MAHESWARI DEVI, Waltair.

Embryology of three species of *Vaccinium*, namely *V. retusum*, *V. serratum* and *V. nummularia* has been studied. The anther structure shows epidermis, two wall layers, secretory type of tapetum and a moderately extensive sporogenous tissue. No fibrous endothecium is differentiated. Pollen mother cells divide in a simultaneous manner. The pollen grains are monocolpate and two-celled. They do not become free from the tetrad and begin to germinate in the anther locule. The ovary is inferior, syncarpous and five-celled. The ovules are tenuinucellate, unitegmic and anatropous. An endothelium is present. A single hypodermal archesporial cell is differentiated. The development of the embryo sac conforms to the Polygonum type. The embryo sac shows normal structure except that the antipodals show a variation in the three species. Fertilisation is porogamous. Endosperm is free nuclear in the beginning and cellular ultimately. Both micropylar and chalazal endosperm haustoria are developed. The fertilised egg divides transversely resulting in the formation of a two-celled preembryo, the terminal cell *ca* and the basal cell *cb*. The derivatives of the terminal cell *ca* contribute to the formation of the embryo proper and a part of the suspensor. The suspensor is long and uniseriate.

There is a diversity of opinion regarding the systematic status of the family Vacciniaceae. Engler and Diels, Rendle and Gundersen put the members of Vacciniaceae as forming the sub family, Vaccinioideae in the family of Ericaceae while others like Bentham and Hooker and Hutchinson treat this as an independent family in the order Ericales.

Vacciniaceae differ from the Ericaceae in that they are characterised by the possession of an inferior ovary, persistent and prominent antipodals, nuclear type of endosperm and in the detailed development of the embryo. They resemble Ericaceae in the features of the anther and pollen, structure and development of the ovule and female gametophyte and formation of endosperm haustoria. The differences, however, seem to justify the recognition of Vacciniaceae as a separate family in the order Ericales as done by Bentham and Hooker and Hutchinson.

72. Embryological studies in Asclepiadaceae.

H. MAHESWARI DEVI, Waltair.

The work represented here comprises an account of the microsporogenesis, male gametophyte, translator, megasporogenesis and female gametophyte of *Calotropis gigantea*, *Pergularia extensa*, *Lepladenia reticulata*, *Ceropegia juncea*, *Tylophora asthmatica* and *Cynanchum callialata* belonging to Cynachoideae and *Hemidesmus indicus* belonging to Periplocoideae. Endosperm development has been studied in *Pergularia extensa*, *Ceropegia juncea* and *Calotropis gigantea*. Development of the embryo and seed has been described in *Calotropis gigantea*.

The anthers are four locular in *Hemidesmus indicus* and bilocular in the remaining forms. The archesporium consists of a plate of 4—7 cells in transverse section in *Hemidesmus indicus* and 5—10 cells in the rest of the forms and each row consists of 9—12 cells in longitudinal section. The anther wall consists of two layers of cells in *Hemidesmus indicus*, *Ceropegia juncea*, three to four layers of cells in *Cynanchum callialata*, *Tylophora asthmatica*, *Lepladenia reticulata* and six layers of cells in *Pergularia extensa* and *Calotropis gigantea*. The tapetum is of secretory type. In all the forms the subepidermal layer develops into the fibrous endothecium, except in *Calotropis gigantea* where no fibrous endothecium has

been differentiated. The primary sporogenous cells directly function as the pollen mother cells. The pollen mother cells divide in a simultaneous manner in *Hemidesmus indicus* and by successive method in the members of the Cynanchoideae. Cytokinesis is by cell plate formation. In *Hemidesmus indicus* all types of tetrads—T-shaped, linear, bilateral and tetrahedral types—are formed. In *Pergularia extensa* both linear and T-shaped tetrads occur. In *Hemidesmus indicus* the pollen remains in tetrads while in others pollinia are formed. The pollen grains are three celled.

In the development of the translator the secretions of the stigmatic ridge become cartilaginous and form the corpusculum. Lateral prolongations develop from this on both sides. In the meanwhile the tapetal secretion, that envelops the pollen grains, extends outward at the stomial region and unites with the lateral processes of the corpusculum to form the retinaculum. The ovary is bicarpellary apocarpous and consists of two distinct styles and a common stigma. The ovules are anatropous, unitegmic and tenuinucellate. The hypodermal archesporial cell develops into the megaspore mother cell. A linear tetrad of megaspores is formed, the chalazal megaspore of which develops into the 8-nucleate embryo sac according to the normal type. Fertilisation is porogamous. Endosperm is of the nuclear type. It becomes cellular at about 16–32 nucleate stage. Embryo development conforms to the Soland type and keys out to the *Linum* variation. Embryological evidences show that the sub-family Periplocoideae is less specialised when compared to the sub-family Cynanchoideae.

73. Embryological studies in two species of *Ventilago*.

C. GAJAPATHY, Combatore.

The present paper deals with a comparative account of the embryology of *Ventilago bombaiensis* Dalz. and *V. calyculata* Tulasne collected from Khandala and Dang's forests, Bombay State. Previous literature on the embryology of Rhamnaceae is reviewed.

The wall of the anther consists of five layers of cells. The endothecium is fibrillar. The glandular tapetal cells are uninucleate to start with; they soon become binucleate and finally quadrinucleate and polyploid due to further divisions and fusions. The haploid number is 12 for both species. The tricolpate mature pollen grain is binucleate at the shedding stage. The semi-inferior ovary encloses in each locule a pendulous, anatropous, crassinucellate, bitegmic ovule attached on the axile placenta. The funicular vascular strand extends right up to the tip of the outer integument. The hypodermal archesporium is single. Multiple archesporial cells are sometimes met with. Development of embryo sac follows Polygonum type. Twin embryo sacs in different stages of development are met with. Various types of abnormal embryo sacs have been recorded. There is a lot of degeneration of ovules and embryo sacs in *V. calyculata*. Double fertilization is observed in *V. bombaiensis*. Endosperm is nuclear. Embryo development follows the Asterad type. The seeds coat is formed by only the outer integument.

74. Pharmacognostic studies on the bark of *Cinnamomum camphora* Nees.

S. C. DATTA and RAI H. N. CHAUDHURI, Calcutta.

The paper deals with detailed macroscopical studies and histological characters of the bark of *Cinnamomum camphora*. The tree is cultivated in India in many places and its bark has recently been found to be used as an adulterant of true

cinnamon which is obtained from *Cinnamomum zeylanicum* Nees. The distinguishing pharmacognostic characters of both barks have been presented in a tabular form for purposes of easy identification.

75. Comparative pharmacognostic studies on the barks of *Ficus bengalensis* Linn. and *Ficus racemosa* Linn. (= *F. glomerata* Roxb.).

S. C. DATTA, Calcutta.

Both the plants are found throughout India and the barks are used in the indigenous system of medicine. The bark of *Ficus bengalensis* is said to have specific properties of reducing the blood sugar in diabetes and the bark of *F. racemosa* is considered of value in dysentery, menorrhagia, and haemoptysis. In commerce, it is often found that one is substituted for the other or these are mixed together, and this paper has been worked out with a view to bring out the distinguishing characters from which the barks can be identified in dried or powdered samples. The morphological and histological characters of the two barks and the pharmacognostic characters of the powders have been presented in this paper.

76. Biological investigations of *Dillenia indica* Linn.

S. C. DATTA, Calcutta.

Interest in the investigation of this plant accrued from a perusal of Ayurvedic literature, according to which the leaves of this plant are reported to have some effect on the fertility of human beings. They have also been reported to have astringent properties and are also used as a food for tussar silk works. Pharmacological investigations carried on in the Central Drugs Laboratory, Calcutta, showed that the leaves are non-toxic, possess tonic properties and induces an increase in the fertility rate of rats. Pharmacognostic characters of the plant and the part used have been worked out and are presented along with the details of pharmacological studies and their statistical significance. Further work is in progress.

77. Propagation of high Quinine yielding *Cinchona*-budding.

SALIL KUMAR CHATTERJEE, Darjeeling.

For stocking *Cinchona* stands with standardised and inherently high performing tree entities it was felt necessary to build up clonal strains from trees characterised by high quinine content and vigour. The possibilities of patch-budding were worked out in detail and the results were interesting.

Experiments to ascertain the longevity of buds of budsticks collected from high graded seed trees showed that the vegetative buds maintain vigour up to 2nd day of collection without injury after which they gradually deteriorated. Beyond the 3rd day the buds could not be used successfully in budding.

The responses of budding in *Cinchona* showed seasonal variation—the optimum period being March-April of the year. The months from July to September and January-February showed no responses.

As regards the suitability of the root-shocks *Cinchona* hybrids proved to be more receptive regarding the taking of buds and also for the quick growth of the desired shoots developed from the high graded foreign-buds.

78. Vegetative propagation of essential oil-yielding plants.

SALIL KUMAR CHATTERJEE, Darjeeling.

Experiments were designed for the vegetative propagation of some of the essential-oil bearing plants (*Pclargonium gravecoleus*; *Lavendula vera* De Cand; *Pogostemon patchouli* Hook.) at Mungpoo, Darjeeling.

The hormones used were Indole butyric acid, Indole acetic acid, Naphthalene acetic acid, Tichlorophenoxyacetic acid and Seradix L15. Standard Immersion method & Concentrated dip methods were found best & followed.

Rooting behaviour of the cuttings of *Geranium* was remarkably improved with treatments of Seradix L15, IBA, MAA & IAA; Seradix L15 being most effective.

Rooting behaviour of the cuttings of *Pogostemon* was greatly enhanced with treatments of IAA, IBA, MAA and Seradix L15; Indole acetic acid being most effective.

In cases with Lavender, rooting was remarkably improved with treatments of NAA, IBA, IAA & Seradix L15; Naphthalene acetic acid being most suitable.

Tichlorophenoxy acetic acid inhibited the rooting behaviour of the cuttings of all the three species. And from the responses towards rooting of different plants it was clear that the relative activities of different hormones and related chemicals varied considerably according to different species.

79. Propagation of high Quinine-yielding Cinchona-intact shoot method.

SALIL KUMAR CHATTERJEE, Darjeeling.

For building up clonal trains from *Cinchona* trees (*C. Ledgeriana* Moes) characterised by high quinine content and vigour, intact shoot method was formed best and widely followed.

Applications of synthetic hormones ensured the process and treated shoots calused and produced root initials within 35—60 days after which they were severed and planted in the nurseries.

Indole butyric acid (IBA) proved to be most effective than all the other hormones (Naphthalene acetic acid; Indole acetic acid; Tichlorophenoxy acetic acid and 2—4 Dichlorophenoxy acetic acid). Next in order of suitability were NAA, IAA, 2-4-D and T-C-P.

The effectiveness of IBA showed seasonal variation, the optimum period for rooting being the months of April and May of the year. June and July treatments were also favourable but the percentage of success were little lesser. In all the cases the higher concentrations proved to have more root-inducing capacity than the lower ones.

During cold months (December, January—February), Alkathene cover proved to be more effective in inducing root initials—humidity and temperature inside being more favourable.

**80. Fibre-yielding weeds of Bombay and its Suburbs. V.--(a) *Urena lobata* Lin.
(b) *Triumfetta pilosa* Roth.**

S. M. BETRABET and B. S. NAVALKAR, Bombay.

As previously remarked in the earlier papers, Jute and other best fibers occupy an important place next to cotton in the world of textiles.

The investigations were carried out with the same aim in view to find out which of the plants available in Bombay and its suburbs, could be used as substitute for jute, as there was an acute shortage of jute in India after Partition in 1947.

From the preliminary observations and phytosociological study it was found that there were many hitherto neglected plants especially belonging to cohort Malvales, which grow abundantly on waste lands of Bombay and its suburbs during rainy season.

Urena lobata Lin. and *Triumfetta pilosa* Roth. are fifth in the series of other plants, previously investigated. (*Malachra capitata* Lin. *Abutilon indicum* Sweet., *Hibiscus species-tetraphylla*, *H. esculentus*, *H. rosasinensis*, *Corchorus species—olitorias*, *C. capsularis*, *C. acutangulus*).

Urena lobata Lin. is a tall shrub, annual in temperate region and perennial in tropical regions. The plant grows sparingly in the waste places of Bombay, but grows in groups in Krishna Giri Upavan—the National Park Area—near Bombay. *Triumfetta pilosa* Roth. is a large branched perennial tropical herb, branches clothed with soft stellate hairs. Flowers yellow in leaf opposed cymes. It is the most common weed of waste lands, grass reserves and road sides of Bombay & suburbs. The experimental part and the methods have been described in the previous papers. The fibres were extracted from the stems at the end of the retting period which varies from 6 to 20 days. The average fiber content assessed on oven dry bases, was 11.2 per cent. The colour, feel and the length of the strands were noted and drying tests were carried out. Schpper's tester was used to find out the intrinsic strength and percentage elongation at break.

From the physical analysis of the characters it can be seen that *Urena lobata* and *Triumfetta pilosa* have the following properties: respectively: Length of the ultimate cells 1.7 and 1.5; Diameter of the ultimate cells 12.5 and 11.3; L/D ratio 135 and 132; Intrinsic strength 1.339 ± 0.0682 and 1.293 ± 0.0739 ; percentage elongation at break 5.40 and 5.25 and regain 11.1 and 10.8 respectively.

The chemical analysis shows that the percentage Ash content of *Urena lobata* and *Triumfetta pilosa* is 1.23 and 1.01; Fat and wax content 0.65; Cellulose 86.90 and 84.75; Lignin content 11.96 and 13.80 and Nitrogen content 0.134 and 0.190.

It can be observed that the fiber of *Urena lobata* compared well with *Malachra capitata*, *Abutilon indicum* and *Hibiscus tetraphyllus* in physical and chemical properties and it can be utilised for making inferior type of wrapping cloth, strings, cords etc. The fiber of *Triumfetta pilosa* can be used for manufacture of coir and especially partially retted fiber for strong canvas and sails cloth for country crafts and ships as they stand the moisture without deteriorating.

81. A brief survey of Xerophytes in Sambalpur.

CHITTA RANJAN MOHANTY, Sambalpur.

To envisage the xeromorphic and xeroplastic characters of the xerophytic plants, the climate of this place provides a nice and a long-drawn range.

Drough escaping forms are frequently met with and most of the examples are furnished by *Astragalus* (Papilionaceae) *Artemisia* (Compositae), *Tribulus* (Zygophyllaceae), *Heliotropium* (Boraginaceae) and many other grasses.

Succulents evidently contribute a large percentage of vegetation to the Xeric-flora of most of the semiarid zones in this district. Towards east the flora abounds in forms belonging to Cactaceae Euphorbiaceae, Portulacaceae and Crassulaceae.

Evidently, the shallow-rooted xericforms like Cacti and leaf succulents like *Agave*, *Aloe*, *Sedum* are highly conspicuous and characteristic.

In majority of the cases the characters prominently manifested are,

- (i) Shiny heavily cutinised leaf surface.
- (ii) Greater density of epidermal hairs.
- (iii) Various modified sunken stomates.

The range of zonation of land and climatic drifts strictly adhere to the natural change of morphological and anatomical characters.

82. Studies in Pollen of Crop Plants—Rye (*Secale cereale* L.) and Barley (*Hordeum vulgare* L.).

B. SEN and GYANENDRA VERMA, Almora.

RYE: Pollen grains of rye are ellipsoidal (60×40 microns) with one germ-pore and slightly granular exine. Maximum growth elongation of pollen tubes of Spring rye was obtained in 20% sucrose solution containing 1% agar, while that of Winter rye in 22.5% sucrose and 1% agar. In case of Spring rye pollen the maximum growth attained in half an hour to an hour, was of the order of 400 to 500 microns and in the case of Winter rye, 500 to 600 microns. The rate of elongation of pollen tubes of Spring rye was found to be 20 to 25 microns per minute during the first six minutes after germination. After 7 to 8 minutes the growth rate gradually declined and by the end of 30 minutes the tubes generally burst.

BARLEY: Media for optimum growth elongation of pollen of 5 new strains of barley viz., Kindred, Titan × Peatland, Warrior, Harlan and Wong were determined. Different media containing 17.5% to 30% sucrose and 1% agar were tried. It was found that barley pollen germinated freely in media containing 20 to 30% sucrose. Maximum elongations of pollen tubes, obtained in media containing 22.5% to 25% sucrose were as follows: Kindred 360 microns, Titan × Peatland 140 microns, Warrior 340 microns, Harlan 180 microns and Wong 160 microns. Neither the average elongation of pollen tubes, nor the sucrose contents in the optimum germinating media could be correlated with the vegetative cycles of different strains of barley.

This work has been carried out in connection with the Scheme of Plant Physiology and Cytology, financed by the I.C.A.R., New Delhi.

83. Systematics of Memecylon—a preliminary survey based on the Sclereid Morphology.

T. ANANDA RAO and K. M. M. DAKSHINI, Dehra Dun.

Recent researches of Rao have revealed that the presence of terminal foliar sclereids is an important generic character of *Memecylon*. On the basis of sclereid morphology three major types are recognised. Filiform sclereids predominate in the majority of species. They are sub-divided into separate sub-classes depending on the nature of the branching and mature cell forms. Similarly in those species exhibiting polymorphic sclereids the latter are segregated into distinct groups taking into consideration the main trends of variations. Thus the taxonomic interest of sclereid-types as an aid in the identification of species of *Memecylon* and the utility of sclereid morphology in the problems of synonymy in the systematic treatment of *Memecylon* is examined by the study of a series of sterile or doubtful material obtained from Central National Herbarium and Circle herbaria of the Botanical Survey of India and an account of the results obtained is presented in this paper.

84. Biology of Flower Pollination.

P. B. SUBATHRA and M. SAROJINI BAI, Annamalainagar.

The study of flower pollination was carried out in 38 species of Annamalainagar flora. In each case, the botanical name of the flower, the family to which it belongs, the pollinating agent and the entomological group of which the pollinating agent is a member have been entered in a tabular form. The following floral adaptations have been observed to be helpful in bringing about entomophily in the

different species concerned : Colour, Scent, Nectar guides, Nectar, Floral mimicry making the flower in some cases look like a butterfly or some other insect and Special floral mechanisms such as herkogamy—piston mechanisms.

While in the majority of the flowers nectar happens to be the food, in some at least the pollen also provides food for the insects.

The flowers may be classified into three important categories in which (1) the same flower is visited by a number of insects (2) the same insect visit a number of flowers, (3) those in which there is a specificity in the relation between the insect and the flower.

In a few cases birds (e.g. *Stereospermum*) bats (e.g. *Bauhinia tomentosa*) and snails (*Chrysanthemum*) have been observed to act as pollinating agents.

85. Studies in Aero-Palynology at Annamalainagar (South India).

R. GANESAN and R. RAGHAVAN, Annamalainagar.

Aero-palynology has been undertaken in this laboratory for the first time. After preliminary observations, regular experimental observations started with effect from the 26th June, 1958. A pollen-catching gadget was installed on the terrace experimental yard of the Department of Botany at a height of about 40 feet, from the ground level. During this term of observation ending 5th September, 1958, 127 round smooth medium pollen grains, 30 round spinous medium pollen-grains were prominently found in addition to few others.

A marked seasonal change in the constitution of the pollen population of the air has been observed. There was a preponderance and exclusive presence of round smooth medium pollen-grains till the 2nd July, 1958. But soon after that round spinous medium sized pollen grains were found mixed up with them. During the latter period however the incidence of round pollen grains has slowly dwindled down by about 50% whereas the incidence of spinous pollen grains has remained constant. A very interesting observation during this period has been a catch of *Aphanocapsa* on 2nd July, 1958. This study is being continued.

86. Stem epidermis as an aid to the identification of some important Indian bamboos.

S. S. GHOSH and B. S. NEGI, Dehra Dun.

Bamboo has assumed an important place among the natural raw materials of India due to its multifarious uses. As specific bamboos are often required for specific purposes, their identification becomes imperative. Unlike the conifers and dicotyledonous woods, it is not possible to recognise various bamboos based on the end grain structure alone on account of great similarity in their anatomical structure. The study of stem epidermis, however, showed great promise in separating different bamboos and the results are reported here.

Of the six most important bamboos studied, namely *Dendrocalamus strictus* Nees, *D. membranaceus* Munro, *Bambusa arundinacea* Willd., *B. polymorpha* Munro, *B. vulgaris* Schrad. and *Melocanna bambusoides* Trin., the following epidermal features were found helpful in separating them. These are (1) shape of the epidermal cells, (2) arrangement and frequency of short cells (silico-suberous couple), (3) occurrence and distribution of exodermal appendages such as spines, bi-cellular and uni-cellular hairs, and (4) distribution of stomata.

In *Bambusa polymorpha* Munro, the long cells are very characteristic. They are erect and rhomboid in shape. Besides bi-cellular hairs and spines, uni-cellular hairs are also present but not observed in others. In the case of *Melocanna*

bambusoides Trin., the long cell is very uniform in width and usually one pair of short cells alternates with it. Bi-cellular hairs are typically fan-shaped. *Dendrocalamus membranaceus* Munro has got 2 pairs of silico-suberous couples though 3 pairs may also be met with. Spines are mostly present while bi-cellular hairs are very few. *Bambusa vulgaris* Schrad. is readily recognisable by the irregular shape of the epidermal cells.

Dendrocalamus strictus Nees and *Bambusa arundinacea* Willd. have got apparent similarity in the general epidermal pattern but can be separated on the basis of stomatal frequency and the number of silico-suberous couple in an unit area. Unlike the other bamboos, these two species are either totally devoid of exodermal appendages or they may be of very rare occurrence.

87. Glimpses of some timbers of North East Frontier Agency and adjoining areas.

S. S. GHOSH and S. K. PURKAYASTHA, Dehra Dun.

The forest flora of North East Frontier Agency and adjoining areas is still imperfectly known. The great earthquake of 1950 which severely damaged these forests, however, gave us an opportunity to have some idea of the forest trees of these regions from the examination of the woods of the uprooted trees which drifted down the Brahmaputra after the earthquake. About 300 representative wood samples supplied by the Assam Forest Department were studied based on their wood anatomy and the results are recorded here. It is interesting to note here that the specimens available for study were mostly light woods, the heavier ones apparently being stuck up in the mud. The examination has revealed the occurrence of both coniferous and dictyodendronous species, the former represented by two families and the latter by 26 families. The affinities of some of these species which appeared to be new to this region have also been discussed.

Among the conifers, there are seven genera, namely *Abies*, *Larix*, *Picea*, *Pinus*, *Tsuga*, *Cupressus*, and *Juniperus*. Interesting among them are the pines which could be distinguished into five groups. Of the two hard pines, one is distinctly *P. insularis* Endl. while the other is very similar to *P. tabulaeformis* Carr. of China. Besides *P. wallichiana* A.B. Jackson and *P. armandi* Franchet, there is another soft pine which differed from the latter mainly in physical properties and could not be identified definitely. The spruce samples differed in some anatomical characters from that of *P. smithiana* (Wall.) Boiss, the western Himalayan spruce. It is probable that these samples might belong to *P. spinulosa* (Griff.) Henry, which occurs in some parts of Eastern Himalaya. All the specimens of cupressus compare very favourably with *C. funebris* Endl. of China.

The largest number of woods belong to dicotyledons, representing 43 genera. These are:—*Magnolia*, *Manglietia*, *Michelia*, *Bombax*, *Kydia calycina*, *K. glabrescens*?, *Sterculia*, *Pterospermum*, *Elacocarpus*, *Evodia*, *Ailanthus grandis*, *Picrasma*, *Canarium*, *Cedrela serrata*, *C. toona*, *C. microcarpa*, *Chukrasia tabularis*, *Dysoxylum*, *Melia*, *Accr*, *Meliosma*, *Mangifera*, *Albizia stipulata*, *Albizia* spp., *Prunus*, *Altingia excelsa*, *Terminalia myriocarpa*, *T. tomentosa*, *Duabanga sonneratioides*, *Sarcosperma*, *Dichopsis*, *Diospyros kaki*, *Fraxinus griffithii*?, *Myristica*, *Bellischmidia*, *Cinnamomum*, *Cryptocarya*, *Lindera*, *Litsea*, *Machilus*, *Phoebe*, *Cleistanthus charticeus*, *Macaranga*, *Holoptelea integrifolia*, *Engelhardtia*, *Betula*, *Alnus nepalensis*, *Populus ciliata*. Among these, *Cedrela serrata* Royle does not appear to have been recorded from Assam so far. The presence of *Diospyros kaki*, *Holoptelea integrifolia* and *Cleistanthus* spp. also indicates that these have a wider distribution than at present known.

88. Studies in Bud protection of plants.

A. GNANAM and P. NARAYANASWAMY, Annamalainagar.

A critical study, including anatomical, has been made on Bud Protection of 74 species spread over 39 families derived from the Annamalainagar flora. This was done with a view to investigate the differences which may be met with the protection of buds from external adverse factors. In making this study account has been taken of both apical and axillary buds. In order to gain an idea of the efficiency of protection of the particular buds a medium longitudinal section and transverse sections were taken of the buds to see the nature of the ptyxis of the protecting organs.

As the result, it has been found that all the species investigated, in respect of the nature of Bud Protection may be classified into six main groups *viz.*, (1) Stipular Type, (2) Leaf base Type, (3) Petiolar type, (4) Older leaf Type, (5) Bud scale Type and (6) Waxy Type. These appear to be of Ecological importance and at the same time they are incidentally helpful in identifying plants at sight.

89. Studies in the phyllotaxy of Tubiflorae.

N. KASINATHAN and D. CHRISTUDAS, Annamalainagar.

Studies on the various types of Phyllotaxy in Tubiflorae were taken with a view to find out whether they bear any relation to Taxonomic groupings of plants. Such a study has given some interesting results.

In Tubiflorae there is a transition from alternate (Bifarious and Spiral) to opposite or whorled phyllotaxy. The primitive families according to Engler and Prantl, like Hydrophyllaceae, Convolvulaceae, Boraginaceae etc., invariably possess alternate phyllotaxy while the advanced families like Verbenaceae, Labiatae and Acanthaceae show opposite or whorled phyllotaxy. In such a phyllotaxy line of evolution, Hydrophyllaceae obviously occupies the lowest rank whereas Labiatae and Acanthaceae represent culminating points. The other families may be said to represent intermediate stages. These are particularly illustrative of the mode of derivation of opposite phyllotaxy from alternate phyllotaxy the change over being from alternate to sub-opposite and from sub-opposite to opposite, the process of transition being accomplished presumably by the condensation or the nondevelopment of the internodes.

90. A note on the Vascular supply to the flower of *Reseda odorata* L.

U. P. SINGH, Nainital.

The transverse section of the pedicel at the base shows six collateral and open vascular bundles arranged in a ring. They divide higher up and ultimately three concentric rings of vascular bundles are established.

The outermost ring consists of twelve vascular bundles, six of which are situated against the sepals, while the other six, alternating with the above, are situated against the petals. The bundles on sepal radii enter the mid-rib of sepals directly, while those of the petal radii split into three each. The central bundle enters the petal while the two laterals enter one in each of the adjacent sepals, as marginal traces. Thus a sepal receives three vascular bundles.

Each stamen receives only one bundle from the middle ring of numerous vascular bundles. The vascular supply of the stamen remains undivided throughout its course.

The innermost ring is formed of six vascular bundles, three bigger and three smaller, alternating with each other. The bigger bundles enter into the placenta while the three smaller form the median strands of the carpel. The placental bundle remains as a single strand throughout the fertile part of each placenta. Higher up, however, they fork into two each to supply the adjacent flaps of the ovary.

91. Floral Anatomy of *Corchorus capsularis* and *C. olitorius*.

S. SEN, S. PAUL and B. C. KUNDU, Barrackpore.

The vascular anatomy of the flowers of the two species of jute, *Corchorus capsularis* and *C. olitorius*, has been found to be different. In the typically hypogynous, pentamerous flowers (sepals and petals often varying from 4 to 7; stamen double the number of petals or more) with little or no fusion of individual members of different whorls, vascularization takes place acropetally from the vascular cylinder at the distal end of the peduncle i.e., torus. *C. olitorius* like other members of the family Tiliaceae, is characterized by the presence of conjoint petal stamen traces and obdiplostemonous flowers. The conjoint petal-stamen traces in *C. olitorius* split, the outer branches forming petal traces and inner branches opposite them forming stamen traces. In *C. capsularis* the stamen traces arise separately and alternating with the petal traces. The development of sepal and carpel vascular traces and their subsequent branching is identical in the two species. This difference in the vascular structure of the flower in two closely related species indicates that, affinities drawn on the basis of floral anatomy, particularly in the family Tiliaceae, is open to question.

92. Origin and Development of fibres in Ramie : *Boehmeria nivea* Gaud.

B. C. KUNDU and SUBIR SEN, Barrackpore.

Boehmeria nivea Gaud, an important fibre yielding plant is of particular interest anatomically for its unusually long bast fibres. A study of their origin reveals that the prosenchymatous initials around the protophloem elements give rise to the phloic fibres. During development and elongation of the stem these initials elaborate and elongate at a rapid rate and become several times longer than the cells of the neighbouring tissues. Cytological changes in the developing fibre is revealed by vacuolation of cytoplasm which begins later than the neighbouring cells. Ultimately karyokinesis starts without being followed by cytokinesis, resulting into multinucleate cells. Transverse septa has often been observed in a few young fibre cells. The prolonged elongation of the young fibre cells, extending them through several internodes, results in a highly complicated method of secondary wall development. Secondary fibre cells arising from cambium cannot develop to such an extent due to their origin in the comparatively mature tissues. Moreover they are uninucleate. Usually in the extraxylary fibre cells, the deposition of secondary wall begins after primary wall nearly completes its growth of extension. In *Boehmeria*, however, the sequence of events i.e., cell elongation and secondary wall deposition are simultaneous. This coordinated process of elaboration and development keeps pace in the elongating zone of the axis, particularly with reference to the apical end of the fibre cells.

93. Endosperm failure in *Medicago sativa*, L.

R. P. ROY and J. SARAN, Patna.

In some fruits of *Medicago sativa* L., only one seed per fruit instead of normally two, was observed. During the early stages of development both the ovules appear normal which presumably are fertilized. But later a considerable size difference is seen between the two, and finally only one seed matures in a fruit. It is found from the cytological studies of the endosperm in both the ovules that the failure in the formation of a normal endosperm presumably results in the death of the small sized young fertilized ovule. Mitoses were typical in the normal type having regular anaphasic separation of 24 chromosomes ($3n$), with the usual occurrence of some polyploid nuclei (where 48 chromosomes $-6n-$ were counted), which is a characteristic feature of the tissue because of its nutritive function.

Atypical mitoses were, however, observed in the other type where about 70% nuclei at anaphase showed aberrations, which can be classified as: Spindle errors (tripolar and quadripolar spindles) resulting in an unequal distribution of chromosomes 25%; Single bridge 10%; Single bridge plus one laggard 15%; Double bridges plus one laggard 5%; One laggard 10%; and two laggards 5%.

These aberrations which are the result of chromosome breakage and reunion, appear to commence with a single chromatid bridge, followed by the bridge-breakage-fusion cycle. The accumulation of these abnormalities reduce the mitotic activity and culminate in the failure of endosperm. This leads to the death of the otherwise normal embryo. Further work is under progress and shall be published in due time.

94. On terminal sclereids and tracheoid idioblasts.

T. ANANDA RAO, Dehra Dun and K. J. MODY, Ahmedabad.

Recently the investigations of Foster (1944) and Rao (1957) have indicated the existence of diversified types of terminal cells at the end of veins in a large or small vein islet. The present study is undertaken to assess the importance of such cells in any comparative morphology and to ascertain the details regarding their morphological relationships. Contrasted forms of terminal cells have been observed in certain species of *Ola* of Olacaceae, *Capparis* of Capparidaceae, *Scaveola* of Goodeniaceae and *Vochisia* of Vochysiaceae.

The present study supports the view that the genus which has well developed terminal tracheoid idioblast will have some species or all species with well developed terminal sclereids. It is further seen that in a single genus exhibiting tracheoid idioblasts and terminal sclereids it is not uncommon to observe in certain vein ends the existence of intermediary cell forms. The exact morphology of intermediary cell forms could be known only by working out their ontogeny in detail. The resulting data would throw very interesting light on the question of homology between various types of cells.

95. A survey of secondary growth in leaves. 2. Secondary growth of the leaves of some arborescent plants and climbers and the partial shoot theory of the leaf.

B. SAMANTARAI and B. K. NANDA, Cuttack.

Secondary growth has been recorded in the old petioles of the leaves of some arborescent plants and climbers. Among the arborescent plants, the petioles of the leaves of *Citrus medica* L. and *Hydnocarpus Kurzii* Warb. are examined. In

their young petioles, the vascular bundles are arranged in the form of a ring and the cambium is inconspicuous, but in the old petioles, due to the activity of the fascicular and interfascicular cambia, a large amount of secondary tissues are differentiated.

Among the climbers, the petioles of *Jasminum flexile* Vahl., *Petraca volubilis* Jacq. and *Aristolochia gigas* Lindl. are studied. The young petioles of the former two exhibit a crescent shaped vascular strand with no trace of cambium or secondary tissue in it but in the latter, the bundles are wide apart and are in a ring showing neither the cambium nor its derivatives. The structure of the vascular tissue is different in all the three in old petioles. In *Jasminum flexile* Vahl. a continuous and compact ring of secondary tissue is formed by the activity of fascicular and interfascicular cambia. In *Petraca volubilis* Jacq. the secondary xylem and phloem strands formed in the above manner, are traversed by medullary rays. In *Aristolochia gigas* Lindl. the secondary tissues are restricted to the respective bundles as they are derived from the fascicular cambium only.

The type of secondary growth found in the old petioles of both arborescent plants and climbers is almost of the same type occurring in their respective stems and thus supports the partial shoot theory of the leaf elaborated by Arber.

96. Seedling anatomy of the family Cucurbitaceas. Part I. Seedling anatomy of *Benicusa hispida*.

J. V. DESHPANDE and S. M. SHETTY, Bombay.

The primary root is tetrarch. The number of metaxylem vessels increases at higher levels and later, due to the development of parenchymatous pith in the centre, the xylem becomes diamond-shaped in T.S. The pith further increases and the four arms of xylem radially split into halves. The splitting results in the formation of four groups of xylem, each composed of a group of metaxylem cells flanked on either side by halves of protoxylems belonging to adjacent arms. During these changes of xylem, the phloem remains unchanged. The vascular bundles are collateral and the protoxylem is tangential. The internal phloem develops at this stage.

The basal region of the hypocotyl shows four bicollateral endarch vascular bundles. At a higher level, the number increases to six, arranged in two groups, at right angles to the cotyledonary plane. The three vascular bundles of each plane fuse and form a bundle-complex. The vascular traces of the cotyledons arise from these bundle-complexes. Each cotyledon receives 4 vascular traces.

97. Correlation of Tissues in Leaves, Part I. Correlation between Vein-islets and Stomata.

B. GUPTA, Calcutta.

It was found that the absolute number of different cells in the lamina is constant in a given species. The bigger or smaller leaves are the result of the state of tangential increase or decrease of area of the individual cells. The relative proportions of different tissues are strikingly constant. The vein-islet number and the stomatal number of lower epidermis, which are highly variable quantities, when counted from the same region and plotted in a correlation curve a significant curve is obtained. This has a 'positive correlation', that is, where one value increases the other corresponding value is increased proportionately. The co-variation between these two numbers was statistically analysed and the result shows that, the co-variation is significant at 1% level of significance, and it was found that there is an association between vein-islet number and stomatal number.

98. Correlation of Tissues in Leaves, Part II. Calculation of vein-islet number.

B. GUPTA, Calcutta.

It was observed that, there is a 'positive correlation' between the vein-islet number and stomatal number of any particular region. Where one increases the other increases also. The relative proportion between stomatal number (lower epidermis) and vein-islet number is constant. The variation in vein-islet number due to increase or decrease of area of the lamina may be regulated if this number is divided by the stomatal number of the same region. As this number is a fraction of unity, this number may be multiplied by 100. This 'calculated vein-islet number' is more uniform than the 'observed vein-islet number'. By this formula the variation of data between different leaves can be reduced not only in case of vein-islet number but also in case of veinlet termination number etc., where area measurement is required to get the intensity of the particular tissue. By statistical calculations, the vein-islet number by this new formula was found to be more useful than the observed vein-islet number.

99. Correlation of Tissues in Leaves, Part III. "Combined vein number".

B. GUPTA, Calcutta.

"Combined vein number" is the sum of vein-islet number and veinlet termination number of a particular area of lamina which is divided by the stomatal number of the same region and multiplied by 100. This number is useful in many cases where vein-islet number or veinlet termination number separately cannot give a distinguishing character. Combined vein number is found to give in many cases distinguishing features between the leaves of two species or sub-species. Also the total variation between vein-islet number and veinlet termination number is greater than the variation in combined vein number. This is because there is a 'negative correlation' between vein-islet number and veinlet termination number. By statistical analysis it was shown that these two numbers vary negatively and the co-variation is significant in 1% level of significance. In all these experiments *Nicotiana plumbaginifolia* Viv. was used to illustrate the correlations.

100. Contribution to the Embryology of *Lagarosiphon roxburghii* Benth.

M. D. PADHYE and Miss HARIPRIYA RAO, Nagpur.

The paper deals with the male and female gametophytes of *Lagarosiphon Roxburghii* Benth.

The male archesporium consists of two to four rows of cells. It cuts off a parietal layer which divides further to form three layers of the anther wall excluding the epidermis. The tapetal cells remain uni-nucleate throughout the development of the anther. No periplasmodium is formed. Endothecium does not develop any fibrous thickenings.

The sporogenous cells function directly as the microspore mother cells. Meiotic divisions are successive and invariably result in isobilateral tetrads of microspores.

Pollen grain develops thin intine and thick exine. The exine develops numerous small spinose projections. Pollen grains are three celled at anthesis.

Ovules are crassinucellate, bitegmic and orthotropous. Micropyle is formed by the inner integument only. The hypodermal archesporium is invariably a single cell. Parietal cell is cut off. The megaspore mother cell forms a row of four megaspores. T-shaped arrangement of the megaspores is also met with. The

chalazal megaspore develops into an eight nucleate embryo sac of the *Polygonum* type. The egg is flask-shaped. The synergids have normal structure and are hooked. Antipodals are three definite cells that are housed in the chalazal pouch of the embryo sac. The secondary nucleus is situated either in the centre of the embryo sac or just below the egg.

101. Contribution to the Embryology of *Polycarpaea Corymbosa* Lamk. and *Mollugo Stricta* Linn. (Syn. *Mollugo pentaphylla* Linn.).

B. G. KSHIRSAGAR, Sangli.

The investigation deals with the development of the male and the female gametophytes of *Polycarpaea corymbosa* Lamk. and *Mollugo stricta* Linn. (Syn. *Mollugo pentaphylla* Linn) members of the families Caryophyllaceae and Molluginaceae respectively.

The various parts of the flower in both the species develop in acropetal succession. The male archesporium is a plate of one to two cells extending over the whole length of the anther. The archesporium divides periclinally and forms four layers of cells in *Mollugo stricta* and five layers of cells in *Polycarpaea corymbosa*. They are epidermis, fibrous endothecium, middle layer(s) and glandular tapetum respectively. The pollen grains are shed at the three-celled stage. They are tri-colpate and psilate. A few cases of pollen grains germinating in situ were observed in both the species in which the tube nucleus shows a lobed appearance.

The ovules are crassinucellar, bitegmic and anacampylotropous. In *Mollugo stricta* an air space is present between the two integuments towards the chalazal side it is absent however, in *Polycarpaea corymbosa*.

The female archesporium consists of a single cell. But occasionally it consists of two cells in *Polycarpaea corymbosa*. The megaspore mother cells undergoes two meiotic divisions and forms a T-shaped tetrad in *Mollugo stricta* and a linear tetrad in *Polycarpaea corymbosa*. The chalazal megaspore functions and develops into an 8-nucleate embryo sac of the Normal type. The synergids are persisting in *Mollugo stricta*. The embryo sac in *Polycarpaea corymbosa* is fusiform and contains starch grains. No such starch grains are present in the embryo sac of *Mollugo stricta*.

102. Notes on the Systematic Anatomy of Vascular Plants—I. *Asteracantha longifolia* Nees.

DIVYA DARSIAN PANT, Allahabad.

The systematic anatomy of the stem, leaf and the thorn of *Asteracantha longifolia* Nees. (Syn. *Hygrophila spinosa* T. Anders.) has been investigated. Among its more interesting features may be mentioned the occurrence of: (i) simple uniseriate and discoid glandular hairs on the stems and leaves, (ii) a well differentiated endodermis in the stem which later gives rise to a periderm, (iii) Caryophyllaceous type of stomata on both surfaces of the leaf, (iv) compound lithocysts formed by the fusion of two or more epidermal cells and (v) conical cystoliths.

The stem-like structure of the thorns (spines) confirms their axial nature,

103. On the Anatomy of Cucurbita Petiole.

CHITTA RANJAN MOHANTY, Sambalpur.

Anatomically, the features met with in the internal structure of the petiole of *Cucurbita* is highly interesting.

To describe it in sequence, a transverse section reveals an uniseriate epiderm with a number of outgrowths which are multicellular hairs. The tabular epidermal cells are more or less cutinised. Since the structural outline of the section is wavy it reveals a number of ridges and furrows. Hypoderm at the ridges is conspicuously collenchymatous. The hypoderm is discontinuous and collenchyma lacks in the Furrowed region. The vascular bundles are arranged either in a ring or in two rings around the hollow pith. The bundles are bicollateral but in cases, the inner phloem is lacking (when present, only a few soft cells which may not be identified as phloem elements). Pith is hollow but there are a few protrusions of a series of rectangular cells inside the pith. As the older anatomists confirm, it is a primitive feature but it may be viewed as analogous to the extension of the epidermal region.

103(a). Phylogenetic affinities of the tribe Salpiglossideae of Solanaceae.

P. N. BHADURI and MADHURI MAJUMDAR, Calcutta.

A comparative study of flower development, floral anatomy, embryology and chromosome behaviour in different members of the tribe Salpiglossideae as well as in *Cestrum* and *Nicotiana* have been made with a view to ascertain how far such observations can be utilised to establish the phylogenetic affinities of the different genera of the tribe Salpiglossideae and to indicate the lines of evolution in the family Solanaceae. The following materials have been used: *Cestrum nocturnum* L.; *Nicotiana plumbaginifolia* Viv.; *Nierembergia hippomanica* Miers.; *Salpiglossis sinuata* Ruiz.; *Schizanthus pinnatus* Ruiz.; *Browallia elata* L. and *Brunfelsia americana* Sw.

The main conclusions arrived at are as follows: *Cestrum*, *Salpiglossis* and *Schizanthus* in their flower development follow the basic plan of Solanaceae indicating close relationship between the tribes Salpiglossideae and Cestreae. The distribution of vascular strands to the carpels which have been worked out in *Cestrum*, *Nicotiana* and *browallia*, is two adaxial bundles per carpel in the tribes Nicandreae, Solaneae and Datureae and one per carpel in the tribe Cestreae. In the tribe Salpiglossideae the supply of the adaxial bundle to carpels follows the same plan as that of Cestreae indicating once again closer affinity between these two tribes. Pollen grains in different genera such as *Cestrum*, *Nierembergia*, *Brunfelsia* and *Schizanthus* are uniform in their size, shape and general morphology suggesting the homogeneity of the group. Origin and development of the female gametophyte in *Schizanthus* having amphitropous ovule is of 'Normal Type' as has been found by Bhaduri in different members of Solanaceae. In the scale of evolution, the campylotropous ovule in *Cestrum* indicates primitiveness of the genus in the family. Basic chromosome numbers in the tribes Nicandreae, Solaneae and Datureae are $n=12$, and $n=10$ and 11 in the tribe Salpiglossideae, whereas in the tribe Cestreae the basic chromosome number is varying from 7, 8, 9, 10, 11 and 12. *Cestrum* with its symmetrical karyotype has the unique basic number $n=8$. On various considerations Cestreae-Cestrinae is considered to be the most primitive group in the family. On the assumption of monophyletic origin of the family the basic number for the family appear to be $n=8$ from which other numbers have been derived.

It has been generally agreed that there are two distinct lines of evolution in the family. These divergent lines may either indicate polyphyletic origin of the

family or, as indicated by the present study, these two lines have evolved from a common stock such as Cestreae-Cestrinae and diverged in two different directions Nicandreae, Solaneae and Datureae on the one hand and Cestreae-Nicotianinae and Salpiglossideae on the other.

All the data obtained so far have been presented in a tabular form and the evolutionary trends in the family have been discussed in the paper.

CYTOLOGY & GENETICS

104. Genetics of Horse Gram (*Dolichos biflorus* L.).

NIRAD K. SEN and J. G. BHUWAL, Kharagpur.

In horse gram the black colour of the seeds and the purple pigment in different parts of the plant are the effects of one gene dominant over the brown colour of seed and green parts. The earliness in flowering of the black seeded varieties tends to be dominant over the lateness of the brown seeded ones. The number of effective factors concerned has been estimated to be about 1.5. The factor for the pigmentation and the factor or factors for the flowering time are independently inherited.

105. Cytological basis for a case of Sterility in a Interspecific Wheat Hybrid.

S. H. TULPULÉ, Poona.

In a population of nearly 150 plants in the F₄ progeny of an interspecific hybrid between *Triticum durum* and *T. dicoccoides*, there were two plants with no seed set in the first tillers. Meiosis in the microsporocytes of these plants has been studied. It was found that there were a number of irregularities in the course of meiosis. These included chromosome fragmentation and stickiness in prophase followed by presence of condensed chromatin material from metaphase onwards, chromatin bridges and lagging chromosomes at Anaphase one and two followed by tetrads with a large number of micronuclei. Thus the sterility in these plants was due to gross meiotic irregularities resulting in the formation of gametes with deficient or duplicate chromosomes.

Particular attention is drawn to the occurrence of fragments even at prophase and the literature on spontaneous chromosome fragmentation has been reviewed. It is very likely that the observed irregularities are due to genic or genomic interactions since the F₁ progeny of the above cross was highly sterile and the subsequent progenies also had some highly sterile plants. Work is in progress to determine the mode of origin and transmission of the factors causing the observed meiotic irregularities.

106. Cytotaxonomical studies on the Economic Plants of Fam. Apocynaceae.

N. N. ROY TAPADAR and NIRAD K. SEN, Kharagpur.

The chromosome complements of 28 economic plants of the Fam. Apocynaceae including 24 species and 16 genera have been studied. The chromosomes are small 0.7 μ to 4.8 μ in length with mostly median or submedian primary constrictions. *Allamanda nerlifolia* and *A. canthartica* have 18 chromosomes, the lowest number, the chromosomes being largest in the family. *A. violacea* has 36 chromosomes. *Thevetia nerlifolia*, *Strophanthus caudatus*, *S. gratus* and *Trachelospermum jasmi-*

noides have 20 chromosomes. *Carissa carandus*, *Rauwolfia serpentina*, *Hunteria corymbosa*, *Holarrhena antidyenterica*, *Ervatamia coronaria*, *E. dichotoma*, *Nerium odorum*, *Aganosma caryophyllata* and *Wrightia coccinea* have 22 chromosomes. *Ervatamia coronaria* double flowered variety has 33 chromosomes, *Alstonia scholaris* 44 and *Rauwolfia canescens* 66 chromosomes. *Plumeria rubra* has 36 chromosomes but *P. alba* 54; *Kopsia fruticosa* has 36 chromosomes but *K. pruniformis* 72. Polyploidy and structural alteration of chromosomes seem to have played important roles in speciation of the economic plants of Apocynaceae.

107. Morphological and Cytological studies of the Diploid and the naturally occurring Tetraploid in *Convolvulus pluricaulis* Chois.

S. L. TANDON, Delhi.

The morphological and cytological comparison between the diploid and the naturally occurring tetraploid of *Convolvulus pluricaulis* Chois. has been presented. The tetraploid showed thick and large leaves with a higher leaf index. An increase in the size of stomata, epidermal and palisade cells was associated with tetraploidy. The number of stomata and epidermal cells per unit area was less in the tetraploid. The tetraploid which was late in flowering further characterised itself by an enlargement in flower, pollen and seed size. The pollen fertility in diploid as well as tetraploid was above 95 per cent.

The chromosome numbers of diploid and tetraploid were determined as $n=9$ and $n=18$, respectively. The details of meiotic division in the two have been described. The cytological data in conjunction with morphological studies suggest that the tetraploid in all probability arose as a result of autopolyploidy or segmental polyploidy.

108. Cytological studies in the Eastern Himalayan species of *Smilacina*.

VIRENDRA KUMAR, Delhi.

Of the four species of this genus occurring in the Himalayas, *S. pallida*, *S. oleracea*, *S. fusca* and *S. oligophylla*—the first three collected from Sikkim and Darjeeling district in Eastern Himalayas, have been dealt with in the present paper.

Somatic chromosome number $2n=36$ in *S. pallida* and *S. oleracea* and $2n=72$ in *S. fusca* has been noted. The last one is a polyploid chromosome number, first time reported for the genus.

Morphologically the karyotype in all the three species is identical in consisting of long, medium and short chromosomes. The long chromosomes are with nearly median and subterminal primary constrictions, medium chromosomes with subterminal primary constrictions and short chromosomes with median as well subterminal primary constrictions. The secondary constrictions have been revealed in the long and medium chromosomes.

Meiosis has been studied in *S. oleracea* and *S. pallida*. At Anaphase I of meiosis certain like dicentric bridges showing various configurations like criss cross, interlocking etc., acentric fragments and stickiness in the separating chromosomes were observed. It reveals heterozygosity for inversions. Such irregularities if otherwise not lethal give rise to new chromosome types, which stand a good chance of preservation and accumulation since the plants can also reproduce by vegetative means. Structural hybridity among the chromosome complement is already known to occur in this as well as the allied genus *Polygonatum*. It probably serves, a pre-requisite for speciation in the group, along with the occurrence of polyploidy.

It is suggested that the various species studied so far represent a polyploid series—since the haploid chromosome number $n=18$ is too high to be the basic chromosome number.

109. Cytological studies on the Himalayan Species of *Polygonatum*,—Group *Oppositifolia*.

VIRENDRA KUMAR, Delhi.

The group *Oppositifolia*, Baker, comprises seven species all of them occurring in Himalayas and adjoining Chinese mountains, the area considered to be the centre of diversification for the genus.

The present paper deals with karyotype study in three of the species *P. Cathcartii*, *P. graminifolium* and *P. oppositifolium*, collected from their natural habitat in Sikkim and Darjeeling district. In all the three species Chromosome number $2n=30$, from somatic root tip plates and $n=15$ from the generative nucleus division in the colchicine treated pollen tube, were recorded.

In general, the karyotype is identical in all the species studied, consisting of one pair of extra long chromosome with nearly median primary constrictions, six pairs of long chromosomes with subterminal primary constrictions and eight pairs of short chromosomes with subterminal and median primary constrictions. The secondary constrictions were revealed in two pairs of long and short chromosomes.

In regard to their morphology, the chromosomes are very much similar to the chromosomes in the group *Verticillata* particularly in the Himalayan forms of *P. verticillatum* ($2n=30$). This fact is suggestive of a closer genetical affinities existing among these two groups.

Since at present the chromosome numbers in four species are known (including the earlier studied species *P. Horkeri*, $2n=30$). The author suggests $n=15$ as the basic chromosome number for the group *Oppositifolia*.

110. Preliminary observations on the radiation-induced Morphological and Cytological responses of Groundnut.

M. G. SRIVASTAVA, Calcutta.

The effects of different doses of X-rays and beta rays (from p^{32} and S^{33}) on 9 Indian varieties of Groundnuts (*Arachis hypogaea* L.) have been investigated. The germination has not been found to be appreciably affected due to radiation treatments but a number of morphological variations and cytological abnormalities have been recorded.

A 'trailing' variant induced by 40,000 r treatment in variety AK 10 has been reported. The normal habit of this variety is erect. The 'trailing variant' is more vigorous than the control and is also slightly higher yielding.

From the variety TMV 2 treated with the initial activity of 3.2 mc of p^{32} , a 'potato leaf' variant with inrolled blades and slightly dissected leaf margins has been isolated. The leaves of this plant are also characterised by thickness and leathery texture. This variant has been compared with the 'cup mutant' grades induced in 'Carolina variety' by X-radiations (Gregory, 1956).

A number of variations in the number of leaflets and partial fusion of 2 or more leaflets of a leaf in the TMV 1 treated with different doses of X-rays have been reported. In addition, Sectional chimaeras in p^{32} treated AK 12—24 and X-ray treated AK 10, have also been recorded. These plants have parts of leaves and stem completely devoid of chlorophyll. These have been attributed to somatic mutations involving genes responsible for the formation of chlorophyll.

A large number of cytological abnormalities in the root tips of p²² treated seedlings of AK 12—24 have been observed. These include bridges, fragments, laggards, extrusion and dicentrics. A number of ordinary and twisted criss-cross bridges have also been recorded. The formation of dicentric chromosomes as a result of induced fragmentation has been discussed and the origin of the criss-cross and twisted bridges in the light of the disposition of the dicentric chromosome to the axis of the spindle has been explained.

Finally, the importance of the morphological variants/mutants has been discussed and further investigations on their genetical constitution have been suggested.

111. Chromosome study in *Wedelia calandulacea* Rich.

Miss TAPATI CHATTERJEE, Calcutta.

Karyotype analysis of *Wedelia calandulacea* ($2n=52$) was done, revealing the presence of a homogeneous complement. Meiosis is regular with 26 clear bivalents at diakinesis and metaphase which suggests its allopolyploid constitution. Beside the normal $2n$ number of chromosomes a number of nuclei were observed with chromosome numbers other than the normal one. As this species produces by both vegetative and sexual means, these varying chromosome numbers in the somatic tissue may contribute in the means of speciation in this species.

112. Effect of X-rays on Meiotic Chromosomes of *Cipura paludosa* Aubl.

ARUN KUMAR SHARMA and CHITRA TALUKDAR, Calcutta.

Flower buds of *Cipura paludosa* ($2n=12$) were irradiated at 1,000r and 4,000r and observations from P.M.C's were made after every 24 hours following irradiation for four consecutive days. The chromosome aberrations noted were lagging, non-disjunction, dicentric bridges, fragments etc. No significant distinction in the aberrations were noticed even after 96 hours and also with increase in dosage suggesting that in this plant the resting premeiotic P.M.Cs are all equally affected by irradiation. The heteromorphic bivalent present in the complement is affected most and the reason for this differential radiosensitivity is their size which is larger than that of the other five bivalents.

113. Chromosomes of *Cycas circinalis*.

ARUN KUMAR SHARMA and MANDIRA CHAUDHURI, Calcutta.

Cytological study of the male and female plant of *Cycas circinalis* was studied from smear preparations of leaf roots with the aid of Aesculin techniques. The somatic complement as well as flower contain 20 chromosomes. One heteromorphic pair was noted in males, one of them having a distinct satellite at the end. This pair is assumed to be the sex chromosomes. The female plants shows no such heteromorphy.

114. Karyological studies in the Genus *Adiantum*.

R. P. ROY and BAXI M. B. SINHA, Patna.

In the present investigation detailed karyotype studies in some seven species of the genus *Adiantum* have been carried out. The species investigated are *A.*

capillus-veneris, *A. caudatum*, *A. peruvianum*, *A. aethiopicum*, *A. trapeziforme*, *A. philippense* (synonym *A. lunulatum*) and *A. tenerum*. As reported earlier (Roy and Sinha, 1958), it has been found that six of them, namely *A. capillus-veneris*, *A. caudatum*, *A. peruvianum*, *A. aethiopicum*, *A. trapeziforme* and *A. tenerum* possess the $2x=60$ while *A. philippense* has got $2x=90$. The detailed karyotype of different species brings out that all of them have chromosomes whose size varies between 7μ to 2μ .

The species *A. capillus-veneris*, *A. caudatum*, *A. aethiopicum*, and *A. tenerum* have mostly isobrachial or V type of chromosomes. In all these four species there is a great regularity in the pattern of the karyotype. Whether the chromosomes are long, medium or of short size, they are always of the common and generalized types i.e. isobrachial.

The species *A. peruvianum*, *A. trapeziforme* and *A. philippense* have two types of chromosomes, some with two constrictions, primary and secondary and others isobrachial as in the other species mentioned above. In *A. peruvianum* there are seven pairs of chromosomes with secondary constrictions, in *A. trapeziforme*, there is one pair, and in *A. philippense* also it is one pair.

The length of the chromosomes in all the species do not seem to be the same. In the species *A. capillus-veneris*, *A. trapeziforme*, *A. peruvianum*, *A. philippense*, *A. aethiopicum*, and *A. tenerum*, the chromosomes are slightly bigger in size than in the species *A. caudatum*, where they are comparatively smaller.

In *A. capillus-veneris* there are eight pairs of chromosomes with median centromeres, while the other twenty-two pairs have centromeres submedian to subterminal. The length varies from 6μ to 3.5μ .

A. caudatum has seventeen pairs of median chromosomes and thirteen pairs of submedian to subterminal ones. The length of the chromosomes varies from 3.5μ to 2μ .

The species *A. peruvianum* has got seven pairs of chromosomes with both primary and secondary constrictions. Thirteen pairs have primary constrictions median in position and ten pairs have primary constrictions submedian to subterminal. The size varies from 5μ to 2.5μ .

In *A. aethiopicum* there are thirteen pairs of chromosomes with median primary constrictions. The other seventeen pairs have submedian to subterminal centromere points. The size varies from 7μ to 3.5μ .

A. trapeziforme has got one pair of chromosome with both primary and secondary constrictions. Twenty pairs of chromosomes have median centromeres and nine pairs submedian to subterminal centromeres. The length varies from 4μ to 2.5μ .

In *A. philippense* one pair again has both primary and secondary constrictions. Nineteen pairs of chromosomes have median centromeres and twenty-five pairs have submedian to subterminal centromeres. The size varies from 5μ to 2.5μ .

The species *A. tenerum* shows sixteen pairs of chromosomes with median centromere points. Fourteen pairs have submedian to subterminal centromeres. The size varies from 5μ to 3.5μ .

Detailed paper will be published later.

115. Endosperm Cytology.

R. P. ROY and J. SARAN, Patna.

Endosperm in most angiosperms is triploid in origin, formed after the fusion of two polar nuclei with one male nucleus. Quicker growth of this tissue than the embryo and its polyploid nature puts it in a physiological advantage to manage for the nutrition of the young developing embryo. Cytological studies of endosperm are important to know its exact morphological nature; and to find out the

cause of sterility where endosperm failure may be responsible for it, as has been reported in the cases of several plants and interspecific hybrids, particularly now when this type of sterility can be overcome by embryo culture.

Chromosomes counts at metaphase of endosperm mitoses were made in plants belonging to different families :

Family.	Plant.	3n chromo- some number	6n. No.	9n. No.	12n No
Papilionaceae	<i>Clitoria ternatea</i> L.	24	48		
	<i>Vigna caljung</i> Rndl.	36	72		
	<i>Medicago sativa</i> L.	24	48		
	<i>Indigofera linifolia</i> Retz.	24	48		
	<i>Trigonella foenumgraecum</i> L.	24	48		96
Apocynaceae	<i>Vinca rosea</i> L.	24	48		
Capparidaceae	<i>Gynandropsis pentaphylla</i>	51		153	
	D.C.				
Solanaceae	<i>Solanum nigrum</i> L.	36	72		144

In all of the above plants the triploid number was observed at early nuclear divisions but later on as the growth of the tissue proceeds, some giant nuclei appear which showed polyploid numbers.

Formation of giant nuclei or the polyploidy in this tissue arises by three means : Fusion of adjacent nuclei during free nucleate stage; endomitosis; and inclusion of more than one nuclei in a cell during cleavage stage. Therefore, in angiosperms, the development endosperm tissue really becomes mixoploid, although to begin with, it may start as a triploid. Further work on other plants where primary endosperm nucleus has other than a triploid constitution is under progress.

116. Studies of Somatic Chromosomes of *Hepea odorata* Roxb.

R. P. ROY and R. P. JHA, Patna.

The present paper is in continuation with the cytological studies in Dipterocarpaceae where the authors have already reported haploid number of chromosomes to be 7 in pollen mother cells of *Hepea odorata*. But Tixier (1953) reported the somatic number in this species to be 20. Therefore the detailed cytological investigations of the plant have been made in this laboratory. In the root tip squash 14 prochromosomes were found at late prophase and at metaphase also 14 chromosomes were clearly counted in a considerable number of cells. Idiogram of the somatic chromosomes has been prepared. This shows the different types of chromosomes as follows : one pair of long chromosomes with median centromere, two pairs of long chromosomes with submedian centromere, two pairs of medium-sized chromosomes with submedian centromere and two pairs of short chromosomes with median centromeres.

117. Cytology of Endosperm in some Dipterocarps and Legumes.

R. P. ROY and R. P. JHA, Patna.

The ploidy of endosperm in angiosperms, to begin with, depends on how many nuclei from the micropylar and chalazal ends take part in the formation of secondary nucleus. This tissue is generally triploid. Even genetic studies with regard

to the Dt gene in Maize has consistently shown it to be a triploid tissue. But cytological studies of the cell components of this tissue is confined to only about half a dozen species. Detailed cytological investigations of the endosperm of some dipterocarpaceous plants as *Vatica grandiflora* and *Hopea odorata* and some leguminous species, namely *Crotolaria juncea*, *Cajanus cajan* and *Delonix regia* have been made. Primarily in all these species, the endosperm starts as a triploid nucleus. But later on, hexaploid, 9-ploid, or even 12-ploid cells are found mixed up with normal triploid cells in the endosperm. Cells showing the following ploidy could be counted at metaphase as given in the table :

Species.	3x No. of chromosomes.	Average No. of nuclei with 3x chromosomes per cell.	6x No. of chromosomes.	Average No. of nuclei with 6x chromosomes per cell.	9x No. of chromosomes.	Average No. of nuclei with 9x chromosomes per cell.	12x No. of chromosomes.	Average No. of nuclei with 12x chromosomes per cell.
<i>Vatica grandiflora</i>	30	35	60	20—22	90	11	120	7—9
<i>Hopea odorata</i>	No nuclei at metaphase could be found where counts could have been made to determine ploidy. Chromosomal aberrations were, however quite common.							
<i>Crotolaria juncea</i>	24	10—12	48	9				
<i>Cajanus cajan</i>	33	30—35	66	15—18	99	9—10		
<i>Delonix regia</i>	42	25	84	15				

Besides these countable cells where ploidy could be clearly determined, an appreciable number of cells showing very large shape of nuclei at resting stage could be seen. These nuclei are obviously of polyploid nature. Then at anaphase, telophase and interphase the following chromosomal aberrations are quite common : nuclei tethered by bridges, laggards, sticky chromosomes forming broad bridges, unequal numbers of chromosomes moving to two separate poles during anaphasic separation, micronuclei, dumbel-shaped nuclei, extremely elongated irregular strands of endosperm nuclei, etc. The frequency of these chromosomal aberrations was much higher in *Vatica grandiflora* than in the other species under investigation. In both species of Dipterocarpaceae, during cellular organisation of the endosperm 1, 2, 3, 4, or even more nuclei were found enclosed within the same cell wall. This presumably leads to the formation of polyploid nuclei. In several cases fusion of adjacent metaphase spindles could be seen indicating the process of origin of polyploid nucleus. Besides the above there is indication in some cells that endomitosis has also played part in the formation of polyploid cells.

Detailed investigations in some more species having triploid endosperm and also in others having diploid, pentaploid or higher-ploid endosperm tissue is in progress.

118. A comparative study of the Cytological effects of Maleic Hydrazide and X-rays.

MISS MARY KORAH and M. G. SRIVASTAVA, Calcutta.

The effects of maleic hydrazide on the cytology of Paddy (*Oryza sativa* L.) using two concentrations (100 p.p.m. and 500 p.p.m.) has been studied. A large number of mitotic abnormalities like fragments, bridges, variations in the chromosome

number etc. have been recorded. The frequency of the aberrations has been worked out and compared with that of the control. There is a direct correspondence between the dose of treatment and frequency of aberrations. In general it has been noted that in M.H., the abnormalities express themselves more frequently at anaphase rather than at metaphase stage.

The effect of X-rays on the cytology of paddy, also using only two doses (1,000r and 500r) has been worked out. A large number of mitotic irregularities, have been recorded and explained. The frequency of these aberrations in relation to the treatments has been investigated.

The combined effect of M.H. and X-rays with treatments using the same two doses has been worked out. The frequency of aberrations in the four cases has been represented in form of a table and two graphs. It has been found that as a result of the combination, the mean of the effect of two separate treatments, is produced. In other words, the effect of the two mutagenic and radiomimetic substances is not additive. Some of the characteristic effects of X-rays on Paddy chromosomes such as the 'looped chromosomes' were found to be absent suggesting a modification of the effect of X-rays.

The various cytological abnormalities recorded in course of the present experiment have been discussed and explained. The possible mechanism of origin of a criss-cross bridge following fragmentation and reunion has been explained.

119. Cytotaxonomic studies on Indian Commelinaceae—A preliminary note.

ROLLA SESHAGIRI RAO, G. PANIGRAHI and R. V. KAMMATHY, Shillong.

The family Commelinaceae comprising about 600 species belonging to 41 genera in the tropical and sub-tropical regions of the globe, is represented in India, according to Hooker, by 76 species under 7 genera. Though considerable attention has been paid by workers in India and abroad to clarify various taxonomic tangles, several ambiguities, particularly on the Indian genera viz. *Commelina*, *Aneilema*, *Murdannia*, *Polia*, *Actisia*, *Cyanotis*, and *Belosynapsis*, still remain unsolved, resulting mainly either in "splitting" or 'merging' of various taxa.

Considering the existence of a range of morphological intergrades, in the family and realising the potential importance of cytological data in solving intricate problems of plant taxonomy in other groups, an attempt is being made to determine afresh the chromosome numbers of the Indian taxa, to raise, if possible, inter-specific hybrids, together ant-ecological data and to re-evaluate the morphological characters of taxonomic importance so as to propose a comprehensive revision of the family. This paper presents field notes and cytological data on a few of the 26 species from Eastern India & compiling different data from all relevant sources, possess the problems awaiting solution in various genera. Further, the cytology of *Commelina undulata* R. Br. with $2n=c. 62$, and $n=32$, *Murdannia gigantea* (R. Br.) Bruck with $n=11$, and *Forrestia hookerii* Hassk. with $2n=c. 36$ turn up as new records by the present workers.

120. Moisture content and radiosensitivity of Seeds of *Trigonella foenum-graecum* Linn.

ARUN KUMAR SHARMA and BASUDEO VARMA, Calcutta.

The present investigation was carried out with a view to find out a correlation between moisture content of the seeds with increasing dosages of X-rays radiation. Dry, twenty-four hours presoaked seeds in tap water and germinated seeds of *Trigonella Foenum-graecum* Linn, were subjected to X-ray dosages of 25r, 1000r and

4000r and observations were made regularly at an interval of twenty-four hours. The general effect was stickiness, formation of somatic bridges, fragmentation of chromosomes and production of variable number of chromosomes in the nuclei. The principal effects of water content on irradiated tissue, mainly involved the frequency of the dividing cells. In higher dosage of 400r, initial germination of the presoaked seeds was not found to be affected as compared to the control, while when dry seeds were irradiated, initial germination frequency as well as the divisional frequency was considerably increased. This may suggest that X-ray was ineffective in inhibiting the germination, because enzymes responsible for germination were already in active condition. It was observed that chromosomal aberrations were comparatively more in presoaked and germinated seeds than dry seeds, which suggest that radiosensitivity is correlated by the availability of H, OH and HO₂ radicals as provided by the increase in moisture content, so far as this species is concerned. Due to the contrasting data of *Vicia sativa*, Linn. presented by Talukdar of this Laboratory, two categories of X-ray action have been postulated, one depending on the availability of H₂O₂ precursors and other independent of it. The data mainly indicate that so far as this species is concerned, lower dosage of X-rays is incapable of producing dosage severe enough to cause inhibition of germination and frequency of division.

121. Cytology of several members of Compositae I.

ARUN KUMAR SHARMA and BASUDEO VARMA, Calcutta.

A cytological study of eight different species, of the family Compositae distributed under six genera has been carried out. The following are the names of the species, with their 2n numbers, investigated : (i) *Vernonia cinerea* Less. (2n=18), (ii) *V. elaeagnifolia* DC. (2n=38), (iii) *Gnaphalium indicum* Linn. (2n=28), (iv) *Eupatorium Ayapana* Vent. (2n=40), (v) *E. odoratum* Linn. (2n=58), (vi) *Eclipta prostrata* (Linn) Linn. (2n=22), (vii) *Erechtites valerianaeifolia* DC. (2n=40), and (viii) *Ageratum conyzoides* Linn. (2n=38). Detailed karyotype has been done in all of them. The normal somatic chromosome number is different in different species; but the number 38 is shown by *Ageratum conyzoides* Linn. and *Vernonia elaeagnifolia* DC. and the number 40 by *Eupatorium Ayapana* Vent. and *Erechtites valerianaeifolia* DC. There is a gross similarity in chromosome morphology of the different species of a group, though numerical difference in their chromosome complement occurs. Somatic reduction has been recorded in *Vernonia elaeagnifolia* DC. Meiosis has been studied only in *Ageratum conyzoides* Linn. Meiosis has been found to be regular. Secondary association between 1st meiotic bivalents reveals the basic number of the species to be eight. Somatic nuclei with chromosome numbers other than the normal one, have been noted in *Vernonia elaeagnifolia* DC., *Eupatorium odoratum* Linn., *Erechtites valerianaeifolia* DC. and *Ageratum conyzoides* Linn.

122. Chromosomal Biotype in *Colocasia antiquorum*.

AMIYA KUMAR SARKAR, Calcutta.

The present investigation has revealed the occurrence of chromosomal biotypes in *Colocasia antiquorum*. Two biotypes have been worked out by the authors having 2n=24 and 38 chromosomes. A few other biotypes are on record. Definite differences in the external morphology have been noted in these types. Karyotypes of the biotypes too have been studied.

123. Cytological effects of X-ray irradiation on dry seeds of Jute.

RABINDRA KRISHNA BASU, Calcutta.

Dry, dormant seeds of five varieties of jute, namely, *Tall Mutant*, *R-26* and *Chinsura Green*, belonging to *Corchorus olitorius* and two varieties of *C. capsularis*, namely, *D 154* and *D 386*, were irradiated with X-rays, the dosages ranging from 6,000 r to 90,000 r. Roots grown from these treated and their respective control seeds were studied cytologically. No difference in the frequency of aberrant cells was observed in dermatogen, periblem and plerome. Analysis of anaphase and telophase stages revealed an increase in the frequency of fragments and interchange bridges with increase in X-ray dosage. The frequency of aberrant cells was found to be more in the varieties of *C. olitorius* than in the varieties of *C. capsularis*.

The fragments were of various sizes, from tiny spheres to the size of the long arm of the longest sub-median chromosome. The bridges were of three types—interchange bridges, sticky bridges and bridges due to delayed separation. The interchange bridges appeared in most cases in pairs, lying parallel to each other, criss-cross and interlocked and were chromosome dicentrics. The total number of fragments exceeded those of the bridges, suggesting other deletions either terminal or interstitial, in addition to the formation of chromosome dicentrics. Relationship of chromosomal aberrations on X-ray dosages and probable mechanism for the production of various structural changes have been discussed.

124. Cytological Studies on *Mirabilis Jalapa*.ARUN KUMAR SHARMA and UPENDRA CHANDRA BHATTACHARYYA,
Calcutta.

The present paper deals with the karyotype details of five different varieties of the species *Mirabilis jalapa*. The $2n$ number in all the varieties has been found to be $2n=58$ and the occurrence of variations from the normal ones has been observed within the same tissue. The chromosomes in general are very short and longer ones among them are provided with secondary constrictions, the number of the latter ranges from 8–16. The short chromosomes are mostly with median primary constrictions, which however form an extremely graded series. The same number but different karyotypes in different varieties suggests the importance of minute karyotypic alterations in the evolution of different varieties.

125. An X-ray induced pleiotropic drastic dwarf mutant and its response to Indoleacetic acid and Gibberallic acid.

V. S. SARMA, Calcutta.

In order to induce artificial mutations in Tezier's Prim, a stable French variety of cultivated tomatoes which is high yielding under the local conditions, dry seeds, 2-day water-soaked seeds and seeds showing incipient germination were irradiated with various dosages of X-rays. In the present report, a drastic recessive dwarf mutant isolated from the X_3 generation of the 8,000 r treatment on dry seeds has been described. The mutant gene in this dwarf mutant suggests a pleiotropic effect. It inhibits the elongation of the internodes, the leaf stalks, the main axis and the stomata; (2) produces changes in the leaf blade of the mature leaves—making it "succulent" and dark blue-green in colour; (3) reduces the number of leaf-lets per frond, flowers and fruits per cluster, the size of the

fruits and the vegetation period; (4) delays the development or maturation period of the flower primordia to anthesis; (5) leads to the abortion of the first formed flowers before their anthesis; (6) increases the period from first flower open to first fruit set; (7) decreases the period from first fruit set to first fruit ripe and (8) changes the structure of the stem, showing several abnormal features. Applications of aqueous solutions of IAA and GA, applied regularly on alternate days to the young, expanding foliage of the mutant plants showed no responses to these growth substances. However, the GA treated plants produced leaves which lost their dentate nature and had nearly entire margins.

126. The Effect of Light on the Mitotic Spindle.

(Mrs.) MRIDULA DATTA, Calcutta.

The endospermial milk in fruits of Palmae provide a natural medium of low refractive index against which the mitotic division of the suspended free nuclei can be watched clearly under high dry power of the light microscope. Under illumination from the microscope light source, the spindle figures of coconut nuclei undergo a slow distortion, the while mitosis is on progress. In *Areca* (betel nut), the changes take place at a faster rate, while progress of division is blocked. The nuclear membrane being persistent, nucleoplasm at all stages remains confined within it. It is recorded, that under illumination, spindle orientation is destroyed and the nuclear get returns to its amorphous form, while the chromosome plate and portion of the spindle immediately adjacent to it, is not disturbed. Visually, the *Areca* spindle shows the photoeffect, by simultaneously decreasing in length and increasing in breadth, till within 15 mts. a spherical form is attained, when it becomes stable. The chromosome plate meanwhile remains unchanged in dimensions or position. The implications of this phenomenon, with reference to spindle substructure, is discussed.

127. Discrimination between two varieties of *Corchorus olitorius* L., with regard to the dimension of leaves.

RABINDRA KRISHNA BASU, Calcutta.

Correct classification among groups of biological materials, differing in a number of variables, is a long known problem. Fisher's introduction of "discriminant function" has solved problems of this type. When one variable is not considered sufficient to avoid misclassification, other variables are considered jointly to suitably discriminate the individuals in respective groups.

In the present investigation, this method has been applied to differentiate quantitatively a mutant type called, *Tall Mutant* from its parent, *R-26*, belonging to *C. olitorius*, with regard to the length and breadth of lamina. Twenty plants from each of the varieties, growing in the same plots and twenty five mature laminae from each plant have been collected at random and measured. By statistical analysis, the best discriminant function for the varieties has been found to be $X = 0.229120x_1 - 0.044056x_2$, where, x_1 and x_2 are the mean length and mean breadth of lamina, in inches, respectively and the difference between the means of X in the two varieties is $D = \bar{X}A - \bar{X}B = 0.120523$, where, $\bar{X}A$ and $\bar{X}B$ are the means of the two varieties. The analysis of variance of X indicates that the discriminating power between the varieties is highly significant. The probability of misclassification has been calculated separately for the length and breadth of lamina. The breadth of lamina does not appear as discriminating as either the length or the discriminant function X .

128. Karyotype in the Eastern Himalayan Forms of *Polygonatum cirrifolium*, Royle.

VIRENDRA KUMAR, Delhi.

The *P. cirrifolium* belongs to the group Verticillata, Baker, having its distribution along the Himalayan range. The centre of diversification of the entire genus being the Eastern Himalayas and Western China. Earlier, the present author investigated the forms occurring in the Western Himalayas and reported diploid chromosome number $2n=38$, a number considered to be unusual for the group Verticillata, since the various other species studied so far have revealed $2n=26, 28, 30$ as the most common diploid chromosome numbers. ($n=13, 14$ being the established basic chromosome numbers). Hence it was suggested in the earlier papers that this increase in the chromosome number could have been brought about by structural changes in the chromosomes followed by chromosome duplication or by hybridization.

In the present study, diploid chromosome numbers $2n=26$ (clones from N. Sikkim) and $2n=28$ (clones from S.-E. Sikkim) have been noted from somatic root tip plates and the division of the generative nucleus in the colchicine treated pollen tubes.

In general, the karyotype is similar to the forms studied earlier from Western Himalayas, in possessing an asymmetrical karyotype consisting of long and short chromosomes. Another more or less constant feature being the presence of seven pairs of long chromosomes with subterminal primary constrictions. The present forms from Eastern Himalayas differ in possessing only six to seven pairs of short chromosomes with median or subterminal primary constrictions, while the Western Himalayan forms possess twelve pairs of short chromosomes.

This evidence suggests that the Western Himalayan forms with chromosome number $2n=38$ have probably arisen from the primitive Eastern Himalayan stock ($2n=26$) by the (i) duplication of the entire set of short chromosomes and (ii) some structural changes involving the entire set of chromosome complement. Thus resulting in the increased chromosome number and new chromosome types. Such changes stand a good chance of preservation, as the plant possesses an efficient mode of vegetative propagation by rhizomes.

129. A new Technique and the Study of Somatic Chromosomes of *Oryza*.

ARUN KUMAR SHARMA and SATYABRATA MUKHOPADHYAY, Calcutta.

A suitable squash technique has been worked out for the study of somatic chromosomes in detail, specially in rice. The present investigation included the species *O. glaberrima*, *O. officinalis*, *O. breviligulata*, *O. latifolia*, *O. eichengeri*, *O. alta*, *O. minuta*, *O. sativa* var *tepa-1*, *O. sativa* var. *satika*, *O. sativa* var. *Patnai-23*. These were collected from Chinsurah Rice Research Station. The method is as follows: Root tips of about 0.75 cm. were cut and pretreated in cold saturated solution of Aesculin in water at freezing temperature for 5 minutes and then for 2 hrs. at 18°C in the same solution. Root tips were then fixed for one hour in propionic acid and absolute alcohol mixture mixed in the proportion of 1:3. Then the root tips were heated for a few seconds in 2% propiono-orcein and normal hydrochloric acid mixture mixed in the proportion of 9:1 and kept in the solution for at least 45 minutes. Exact tip portion of roots were mounted in 1% aceto-orcein mixture on a grease free slide. Sufficient and uniform pressure was applied with the help of blotting paper and coverslip was sealed for study. It is revealed from the study of such temporary preparations that species differ not only in respect of chromosome number but also in the size and position of the primary and secondary constriction regions.

130. Study of Meiosis in the Tetraploid Species of the Genus *Oryza* and its bearing on Speciation.

D. V. SESHU, Cuttack.

Studies were made of meiosis in the pollen mother cells of six tetraploid species of *Oryza*. These were *O. alta*, *O. latifolia*, *O. coarctata*, *O. ridleyi*, *O. malampuzhaensis* and *O. punctata*. Of these the last named species, *O. punctata* was received with the specific nomenclature, *O. weinfurthiana* from Belgian Congo. This species has the chromosome number $2n=48$ and is the first record of its number. In the meiosis of these species, quadrivalents were observed, the mean frequency per cell at diakinesis being 2.30 in *O. alta*; 1.05 in *O. coarctata*; 0.76 in *O. latifolia*; 0.42 in *O. ridleyi*; 0.38 in *O. punctata* and 0.35 in *O. malampuzhaensis*. Other abnormalities like anaphase bridges were observed in the species *O. coarctata* and *O. ridleyi* at a low frequency. The chromosome size and configuration was similar in all the species. The cytological details along with the morphological characters of the species could be used to deduce their probable origin from diploid ancestors. This is discussed in relation to lines of investigations of evolution of species, and tracing speciation in the genus.

131. Variability in *Oryza Officinalis* Wall.

S. SAMPATH and D. V. SESHU, Cuttack.

Different samples of seeds of *O. officinalis* Wall. received from Daungs (Bombay), Assam, Burma, Ceylon and Bangkok showed differences in vegetative and floral characters. The main differences were in rhizome development, habit, anthocyanin pigmentation, ligule fringing, spikelet number, shape and size. Some differences in response to photoperiods as well as adaptation to shade were also seen. Two natural mutations in the variety from Burma showed quadrivalency at meiosis, semi-sterility, as well as changed photoperiod response. The variability within this species shows some parallelism to variability within the genus as can be expected from the law of Homologous Variation. The variability also suggests a trend in speciation in the genus by segmental allopolyploidy.

132. Morphology of the *Hibiscus cannabinus* X *H. radiatus* hybrid.

S. C. RAKSHIT, P. SANYAL, and B. C. KUNDU, Barrackpore.

In order to incorporate disease resistance character to *Hibiscus cannabinus* an important substitute for jute, but which is highly susceptible to various diseases, attempts were made to hybridize *H. cannabinus* ($2n=36$) with five other disease resistance species of *Hibiscus* viz., *H. sabdariffa* ($2n=72$), *H. radiatus* ($2n=72$), *H. panduriformis* ($2n=24$), *H. lunatifolius* ($2n=40$) and *H. vitifolius* ($2n=34+0-1B$). Successful hybrids were obtained only from crosses between *H. cannabinus* and *H. radiatus* in both directions.

The pollen and seed fertility of F_1 hybrids in general were extremely poor as compared to the parents. Many characters in F_1 hybrids were intermediate, a few like *cannabinus* and others like *radiatus*. The intermediate condition of branching habit, presence of few prickles on the stem, corolla colour, size of calyx tooth, colour and size of staminal column, shape of ovary and capsule etc. need special mention.

The morphological characters of only 41 F_1 plants could be studied. Of these F_1 population, 17 plants were like *H. cannabinus*, 3 like the F_1 hybrid. The

remaining 21 plants besides some parental characters (both *cannabinus* and *radialus*) and F_1 characters also showed some peculiar and new morphological characters and have been described in the present investigation. No plant with completely *radialus* like characters could be obtained so far in F_2 population.

Due to extreme low population, the ephenotypic classification of the F_2 families could not be made.

133. Study of induced mutation in *Streptomyces* sp. a pink coloured strain.

SANKAR LAL CHAKRABARTY and P. NANDI, Calcutta.

Out of large number of *Streptomyces* strains isolated from different soil samples —Ac 21(460) was selected for detailed studies for its pink colour, morphological variability, production of white secondary mycelium and antibiotic activity. The effect of ultra violet rays (100 ergs mm.²/sec.) was studied by radiating the spore suspension for 20, 40, 60 and 80 seconds respectively. Plating was done into complete medium. In this medium most of the nutritional factors are present and the mutants are therefore expected to grow in it without showing any sign of deficiency. The percentage survival of the colonies was 9.7%, 1.3%, 0.21% and 0.03% at 20, 40, 60 and 80 seconds respectively.

The isolations of mutants were done satisfactorily by total isolation method of Fries into minimal media in order to characterise the biochemical and morphological mutants. The percentage of biochemical mutants was 1.86%, 0.92%, 0.62% and 0.57% and that of morphological mutants was 11.1%, 10.7%, 6.9% and 6.5% at 20, 40, 60 and 80 seconds exposure respectively. The characterisation of these biochemical and morphological mutants is now in progress.

The effect of radiation on the increase of antibiotic yield showed that in majority of the cases the antibiotic property was increased as found by the inhibition zone against the test organism, *Curvularia* sp. while in others this property was decreased.

134. Useful morphological effects of X-ray and P^{32} beta ray irradiations on Jute seeds.

RABINDRA KRISHNA BASU, Calcutta.

Dry seeds of three varieties of *Corchorus olitorius*, namely *Tall Mutant*, R-26 and *Chinsura Green* and two varieties of *C. capsularis*, namely, D 154 and D 386 were irradiated with X-rays and beta rays from P^{32} and S^{32} , the dosages ranging from 6,000 r to 90,000 r and from 0.005 μ c/seed to 7.500 μ c/seed respectively. The growth of the apical meristems of the stems were affected and various kinds of abnormalities, mostly affecting stems and leaves appeared during the early growth of the treated plants in the first generation. All stem abnormalities like single, double or more bifurcation of stem, expessive lateral branching and fasciation continued to remain till the harvest time, while most leaf abnormalities did not continue beyond the sixth or seventh leaf stage. Investigations on the bifurcations of stems have been reported in detail.

Considerable variations between plants with a treatment as well as between irradiations with X-rays and beta rays from P^{32} were observed, both in the form and frequencies of bifurcated plants. The maximum frequency of plants with bfurcations in the X_1 and P_1 population were 22.1 and 48.4 percent of the plants studied, respectively. The frequency of bifurcations from internodes was more in the varieties of *C. olitorius* compared to the varieties of *C. capsularis*, where

excessive lateral branching exceeded the frequency of bifurcations. The expression of this radiation effect depended to a large extent on the environmental conditions. The number of bifurcations, per plant varied from 0—3 and 0—5 in the X_1 and P_1 populations respectively. No bifurcations were observed in the S_1 population.

Variations were also observed in the region of occurrence of bifurcation on the stem in both the X_1 and P_1 population. About 89% in the case of X-rays and about 94% of the plants in the case of beta ray irradiations from P^{32} , developed various forms of bifurcations within 60 cm. from the soil level. By increasing the number of branches from near the soil level, it was possible to obtain more fibre and wood per plant in most of the treated populations of *C. olitorius*, while in most of the treated populations in *C. capsularis*, retting was more difficult due to excessive lateral branching. The difference in the responses to irradiations with reference to the induction of bifurcations were found at the species level only. The probable mechanism of induction of bifurcation has been discussed. Progeny tests of a large number of plants with this radiation effect revealed no genetical back-ground and the phenomenon of bifurcation of stem was considered as an abnormality rather than mutation.

135. Cytotaxonomy of a Few Orchid Genera.

ARUNKUMAR SHARMA and ASOK KUMAR CHATTERJI, Calcutta.

The paper reports a thorough cytological study of several genera and species of the Tribe II. Vandae of Hooker's Orchidaceae.

The numbers recorded in different species is given below :—

(1) <i>Vanda Roxburghi</i>	...	...	...	$2n=38$
	(variation numbers	44, 42)		
(2) <i>V. teres</i>	...	...	...	$2n=38$
	(variation—35)			
(3) <i>Aerides affine</i>	...	...	...	$2n=40$
	(variation—37, 22)			
(4) <i>Rhynchostylis retusa</i>	...	...	...	$2n=38$
(5) <i>Renanthera coccinea</i>	...	...	...	$2n=38$
(6) <i>Cymbidium aloefolium</i>	...	...	...	$2n=40$
	(variations—38, 40, 50)			
(7) <i>Oncidium lanceanum</i>	...	...	...	$2n=26$
(8) <i>Phaelanopsis manii</i>	...	...	...	$2n=38$
(9) <i>Sarcanthus spp.</i>	...	...	...	$2n=38$
	(variations—36, 32)			

The abnormal roots, due to their epiphytic nature presented difficulties in proper fixation which has been overcome by the use of Paradichloro-benzene and Aesculin, both altering the saturation of the solutions and time period of treatment.

From the cytological data including the study of the karyotype, the role of polyploidy (both euploidy and aneuploidy) and structural alteration have been emphasized in the evolution of different genera and species.

136. Biosystematics of *Sisymbrium irio* Complex IX. Genome Analysis.

T. N. KHOSHOO, Amritsar.

The basic chromosome number of the complex is 7 and the ploidy level ranges from $2x$ to $8x$. A critical analysis of the chromosome associations at dia-

kinesis and metaphase-I of the various races and spontaneous and artificial hybrids has been made. The most common (often in 70% cells) associations are: Diploid, 7 bivalents; Colchic-autotetraploid, 7 quadrivalents; Tetraploid, 14 bivalents; Hexaploid, 21 bivalents; Octoploid, 12-0 quadrivalents+4-28 bivalents; Polyhaploid (from Tetraploid), 14 univalents; Triploid (Diploid \times Tetraploid), 7 bivalents+7 univalents and Hybrid tetraploid (Autotetraploid \times Tetraploid), 7 bivalents+14 univalents. Furthermore, the hexaploid and the octoploid have been demonstrated to have arisen by the gametic doubling of the triploid and the tetraploid respectively.

In view of the above data, the various evidences point out that if the genomic constitution of the diploid race is denoted as AA_1 , then that of the tetraploid is $2A_1 2B$. The hexaploid has a constitution like $2A 2A_1 2B$, while the octoploid has $4A_1 4B$. Following the nomenclature of Stebbins, the tetraploid is a genomic allotetraploid. The hexaploid is an auto-allohexaploid, whose autopolyploid portion is in itself segmental-allopolyploid in character. The octoploid is an auto-allo-octoploid.

The pairing in the polyhaploid plant and the increased pairing (i.e. more than 7 bivalents and/or occasional trivalent formation) in the triploid indicate that the A and A_1 genomes on one hand, and the B genome on the other, are not entirely non-homologous. There appear to be some duplicated segments distributed randomly among the chromosomes of the A genomes and the B genome. Ordinarily such homologous associations are suppressed, whether due to the strong preferential pairing or due to some, hitherto unravelled, genotypic control. This means that the symbols A and B do not convey the real cytogenetical nature of the genomes.

The taxonomic implications of the present analysis have been discussed.

137. A Cytotaxonomic Study of the West Himalayan Polygonateae.

P. N. MEHRA and R. S. PATHANIA, Amritsar.

As at present constituted, the Liliaceous tribe Polygonateae includes nine genera, Hutchinson (1934). Of these only three namely *Polygonatum* Miller, *Disporum* Salisb., ex D. Don and *Smilacina* Desf. are met with in the North Western Himalayas at an altitude of 2,3,000 metres. The cytology of all the species belonging to these occurring in the area has been worked out. Collections were made from Dalhousie, Simla and Mussoorie.

Polygonatum Miller—Three species of this genus are met with. *Polygonatum multiflorum* All.: Chromosome number was determined from root tip mitoses, pollen mitoses, and pollen mother cells. The somatic number from root tips is $2n=22$. The karyotype is of the symmetrical type with five pairs of long and six pairs of short chromosomes. Size range of the chromosomes is from $8\frac{1}{2}$ - 3μ . Meiosis is perfectly normal showing eleven bivalents at metaphase I. This number $2n=22$ and $n=11$ is a new report for the species. *Polygonatum verticillatum* All.: Chromosomes were studied from the root tips and pollen mother cells. The somatic number is $2n=66$. The karyotype is of the symmetrical type with a gradual transition from very long to very short chromosomes. Size range of the chromosomes is from $9\frac{1}{2}$ - $1\frac{3}{4}\mu$. Meiosis in this taxon is highly irregular showing chromatin bridges, univalents and multivalents. The chromosome number $2n=66$ for *P. verticillatum* is a new report not having been recorded so far in any species of the genus. *Polygonatum sibiricum* Red.: Chromosome number was determined from root tips, pollen mitoses, and pollen mother cells. Root tips showed $2n=36$ chromosomes. Karyotype is of the asymmetrical type with eight pairs of long and ten pairs of short chromosomes. Size range of the chromosomes is from $6\frac{1}{2}$ to 2μ . Meiosis is perfectly normal showing eighteen bivalents. The chromosome number $2n=36$ and $n=18$ is a new record for the species.

Disporum Salisb., ex D. Don.—Only one species *Disporum cantoniense* (Lour.) Merr. occurs in the N.W. Himalayas. Chromosome number was determined from root tips which show $2n=16$. The karyotype is of the symmetrical type with eight long and eight medium sized chromosomes. Size range of the chromosomes is from $15\frac{1}{2}$ to 6μ . Its karyotype is different from the Japanese taxon which however has the same chromosome number.

Smilacina Desf.—Only one species *Smilacina purpurea* Wall. occurs in the N.W. Himalayas. Chromosome number was determined from pollen mitoses and the haploid complement showed 18 chromosomes. Karyotype is symmetrical with ten long and eight comparatively shorter chromosomes. Size range of the chromosomes is from 12 to 14μ . This is a new report for the species.

Cytotaxonomy of the species investigated is discussed.

138. Cytological Observations on Sikkim Species of *Athyrium*.

S. S. BIR, Amritsar.

In an attempt to evaluate the phylogeny of controversial fern genera, *Athyrium* Roth and *Diplazium* Swartz, cytotaxonomic investigations on their Himalayan representatives are being carried out. *Athyrium* (sensu stricto) is very widely distributed and in the Himalayas alone, it is represented by about 25 species (also including the varieties that have hitherto been raised to specific rank). However, this number is bound to increase because of the present imperfect taxonomic status of some of these ferns.

The present communication deals with the cytological aspect of 13¹ species of *Athyrium* from North Sikkim, Eastern Himalayas. Meiosis has been critically examined by aceto-carmin squash technique and found to be perfectly normal. All of these species are sexual and produce 64 normal seemingly viable spores. Most of the species which were studied by Mehra and Verma from Darjeeling, also occur within the area and show the same cytological status and accordingly these were left out of this report. Except for one, namely, *A. schimperii* Mong (Singhik, 6,000 ft. alt.), all the species grow at higher altitudes in the Lachen valley, N. Sikkim, between 8,000–14,000 ft. alt. The names of the species marked thus (*) are entirely on Prof. R. C. Ching's (Academia Sinica, Peking) authority. The descriptions of new species, varieties and combinations referred to here, are intended to be published separately.

Out of these, **Athyrium Tsail* Ching (Ms.), *A. rupicola* (Hope) C. Chr., **A. parasnathensis* (Clarke) Ching (Ms.), **A. himalaicum* Ching (Ms.), **A. Birii* Ching (Ms.), *A. rubricaulis* (Edgew.) Bir (Stat. nov), *A. Mehrii* Bir (species nov), *A. aff. flabellulatum* (Clarke) Tard., *A. schimperii* Mong., and *A. subtriangulare* (Hook.) Bedd. var. *sikkimensis* Bir (var. nov) are all diploids with $n=40$ while three species namely *A. subtriangulare* (Hook.) Bedd., *A. spinulosum* (Maxim) Milde and **A. polyspora* (Clarke) Ching (Ms.) are tetraploids ($n=80$). One species, *A. attenuatum* (Clarke) Tagawa showed intraspecific euploidy, both diploid and tetraploid races are present in the area. Polyploidy encountered is only up to tetraploid level.

Out of a total of 36 species worked out so far only one has been found to be apogamous. This ultimately disproves Mahabale et al's observation that most of the species of *Athyrium* are apogamous. Likewise Europe, Himalayas represent temperate climate and out of atleast 24 clear cut species worked out from this region 75% are diploids (rest only tetraploids) while from Ceylon with tropical climate, upto now no diploid species has been found and there the grade of ploidy

* *Athyrium himalaicum* Ching and *A. Birii* Ching are new species found by the writer during the course of present investigations. These were sent to Prof. R. C. Ching for opinion and have been named as such by him.

is much higher. Keeping in view the data about Ceylon species of *Athyrium* that is at present available, this analysis appears to give a rather strong support to Manton's observation that "evolution is proceeding faster in tropics than in temperate latitudes".

Further comparisons with allied genera such as *Diplazium* Sw., *Diplazopsis* C. Chr., *Cystopteris* Bernh. etc. have been made.

139. Cytology of the North-West Indian Compositae.

P. N. MEHRA and S. S. SIDHU, Amritsar.

41 species of the family belonging to 30 genera have been worked out cytologically. Of these the chromosome number in 28 species and 10 genera is reported for the first time. The results are tabulated below.

Species	n number (meiotic studies)	2n num
1. <i>Vernonia cinerea</i> Lees.	9	18
** 2. <i>V. cinerascens</i> Schulz-Bip.	10	...
** 3. <i>V. anthelmintica</i> Willd (= <i>Centratherum</i> <i>anthelmintica</i> Dryand).	10	...
4. <i>Ageratum conyzoides</i> Linn.	10	...
* 5. <i>Dichrocephala latifolia</i> DC.	...	18
* 6. <i>Cyathocline lyrata</i> Cass.	11	...
* 7. <i>Myriactis wallichii</i> Lees.	...	36
** 8. <i>Aster molliusculus</i> Wall.	...	36
** 9. <i>A. Thomsoni</i> Clarke Camp.	9	...
** 10. <i>Erigeron inifolius</i> Linn.	...	27
* 11. <i>Conyza stricta</i> Willd.	9	...
* 12. <i>C. ambigua</i> Willd.	27	...
* 13. <i>Blumea lacera</i> DC.	11	...
* 14. <i>B. membranacea</i> DC.	11	...
* 15. <i>B. Wightiana</i> DC.	9	18
* 16. <i>B. sp.</i>	9	...
* 17. <i>Laggera aurita</i> Schulz-Bip.	10	...
* 18. <i>Vicoa vestita</i> Benth.	9	...
* 19. <i>V. indica</i> DC. (= <i>V. auriculata</i> Cass.)	9	...
* 20. <i>Ifloga fontanessii</i> Cass.	7	...
21. <i>Xanthium strumarium</i> Linn.	18	...
* 22. <i>Eclipta alba</i> Hassk.	11	...
23. <i>Tridax procumbens</i> Linn.	18	...
* 24. <i>Stegesbeckia orientalis</i> Linn.	15	...
	30	60
25. <i>Bidens wallichii</i> DC. (= <i>B. pilosa</i> var. <i>bipinnata</i> Linn.)	36	...
26. <i>Galinsoga parviflora</i> Cav.	8	...
** 27. <i>Cotula hemispherica</i> Wall.	10	20
28. <i>Emilia sonchifolia</i> DC.	5	...
** 29. <i>Gynura angulosa</i> DC.	9	...
** 30. <i>Echinops echinatus</i> DC.	14	...
** 31. <i>Cnicus arvensis</i> Hoffm.	17	34
** 32. <i>C. argyranthus</i> DC.	16 or 17?	...
33. <i>Carthamus oxycanth</i> Bieb.	12	...

Species	n number (meiotic studies)	2n number
34. <i>Cichorium intybus</i> Linn.	9	...
** 35. <i>Lactuca scariola</i> Linn.	9	...
** 36. <i>L. dissecta</i> Don Prodr.	8	...
37. <i>Sonchus asper</i> Vieb.	9	...
38. <i>S. oleraceus</i> Linn.	16	...
* 39. <i>Picridium tingitanum</i> Desf.	9	...
40. <i>Launea nudicaulis</i> Lees.	9	...
41. <i>Youngia japonica</i> DC. (= <i>Crepis japonica</i> Benth.)		
(a) Amritsar type	8	...
(b) Pathankote type	8	...

In conclusion it may be stated that, (1) a new base number 10 is found in the tribe Vernonieae in addition to the already known 9 and 11; (2) *Aster molliusculus* Wall. is a tetraploid with probably 3 genomes in its constitution and may be represented as AA BC; (3) *Erigeron linifolius* Linn. is a triploid and does not set seeds; (4) *Tridax procumbens* Linn., on the basis of meiotic studies, is considered to be a structural hybrid; (5) Intra-specific polyploidy is found to occur in *Siegesbeckia orientalis* Linn. and includes a diploid race ($2n=30$) and a tetraploid one ($2n=60$); (6) two morphologically distinct types but with same chromosome number are recorded in *Youngia japonica* DC; (7) the basic chromosome number 5 is proposed for the family.

140. Cytology of Some 'Acrostichoid' Ferns.

S. S. BIR, Amritsar.

Three Eastern Himalayan ferns with well pronounced 'acrostichoid' soral surface have been cytologically examined and meiotic chromosome numbers determined by acetocarmine squash technique. These belong to two very widely different genera of ferns, namely, *Elaphoglossum* Schott and *Paraleptochilus* Copel. In these the leaves are dimorphic and the fertile ones are very rare.

Two species of *Elaphoglossum*, *E. conforme* (Sw.) Schott and *E. laurifolium* (Thours) Moore (Syn. *E. latifolium* Bedd. Handb. 418. t. 248) were collected. The former is common near Sidrapong (2,500 ft. alt.), Darjeeling, while the latter is abundant on moist rocks in North Sikkim state along Gangtok-Dickchu and Dickchu-Singhik Roads (between 3,000—5,000 ft.). These two species are strikingly similar and can only be distinguished on close examination. *E. laurifolium* is characterised by the diaphanous margin of sterile frond, thickly clavate apices of veinlets falling short of margin and scale bases not sheathing. In the other species, *E. conforme*, the veins are simply forked and reach the margin. *E. laurifolium* has been recorded for the first time from the Himalayas. Both the species are tetraploid with $n=82$ and are based on 41.

The 'Polypodioid' genus, *Paraleptochilus* has 2—3 species and the type species, namely, *P. decurrens* (Blume) Copel. (Syn. *Gymnopteris variabilis* Bedd. Handb. 429. t. 258) is the only representative in India. It grows on shaded rocks and is extremely rare. Only one individual was collected along the Teesta-Manjitar Road, Darjeeling District. At late diakinesis 36 bivalents have undoubtedly been counted. This is a first report of chromosome number for *Paraleptochilus*. This is the diploid

* Genera reported for the first time.

** Species reported for the first time.

number since the allied genus *Leptochilus* with which it has often been merged (cf. Holttum, 1954), has also the base number 36 (cf. Manton and Sledge, 1954).

All the three plants investigated here show normal meiosis and produce viable spores. The systematic position of two genera is discussed in the light of cytological evidence.

141. A preliminary study of meiotic nucleolus in *Sesamum orientale* L.

G. G. NAIR, Calcutta.

The paper deals with an approach to varietal differentiation in *Sesamum orientale* L., by the study of meiotic nucleolus. The different varieties under investigation are, *types 10, 12, 16 and 20* of West Bengal and *TMV 1* of Madras. *Types 12 and 16* are black seeded, while *types 10, 20 and TMV 1* are brown to reddish brown. Meiosis was studied from pollen mother cells. The resting pollen mother cell of the black seeded *types 12 and 16* have one big, perfectly stained nucleolus, while *types 10, 20 and TMV 1* have an additional smaller nucleolus. In all the types, the bigger nucleolus was observed to disappear towards the end of prophase, while the smaller one in the brown seeded varieties persists throughout the division stages up to tetrad. Thus, in the two seed-colour groups, black and brown, there is, however, inter-group difference in the absence or presence of this "persisting nucleolus".

142. Differential Effect of the Incorporation of RNA and DNA in Plant Tissue.

ARUN KUMAR SHARMA and ARCHANA SHARMA, Calcutta.

The effect of different concentrations of ribonucleic acid (RNA) and desoxyribonucleic acid (DNA) has been studied on meristematic somatic cells of *Allium cepa*. The principal effects noted with both are polyploidy and reductional separation of chromosomes.

It has been assumed that RNA causes viscosity change in the plasma, which is responsible for polyploidy. DNA, though entering in a minute quantity due to its high molecular weight, gets converted into RNA precursors and ultimately causes the same effect. Somatic reduction is caused by an increase in the DNA content of the plasma and as such, application of this chemical causes reductional separation of chromosomes. RNA, on the other hand, is gradually converted into DNA precursors to cause this effect. The interconvertible nature of the two nucleic acids, within the tissue, allows the simultaneous occurrence of polyploidy and somatic reduction after a brief interval following artificial treatment.

PLANT PHYSIOLOGY

143. Effect of Gibberellic Acid on Certain Horticultural Plants Cultivated in India.

S. C. CHAKRAVARTI, Mhow.

Present investigation was undertaken during the winter months to find out the effect of gibberellic acid (GA) on (a) woody perennials :—*Hamelia patens* Jacq., *Ixora macrothyrsa* Moore, *Justicia carnea* Hook., *Lawsonia alba* Lam., *Nerium oleander* L. and *Psidium guajava* L. and (b) annuals :—*Dianthus barbatus* L., Aqueous solution of the chemical was applied once to several times in the concentration of 100 ppm. in the case of *Linaria maroccana* Hook., *Phlox drummondii* Hook. and *Zinnia elegans* Jack.

trations of 200, 100 and 10 ppm. to their shoot apices. Treatment failed to induce extension growth in *Psidium*, *Ixora* and *Nerium*.

A change in the shape of the leaves from lanceolate to linear and in their arrangement from whorled to alternate, crowding of flower beds at the apex of the inflorescence axis and earliness in flowering upto 12 days have been recorded in *Linaria marocanna* Hook. In *Hamelia patens* Jacq. GA treatment resulted in the breaking of dormancy of the lateral buds and in change from the winter form consisting of rosette of ovate leaves terminating the shoot to the summer one of normal elongated internodes with lanceolate leaves and their reversal back to the original condition within a month of the cessation of the treatment.

Death of the terminal meristem resulting in cessation of growth in *Lawsonia alba* and in the development of abortive inflorescence in *Justicia carnea* has been recorded in the treated plants. This gives the possibility of using GA sprays, which is effective in as low a concentration as 10 ppm. to replace hand pruning of *Lawsonia*, one of the commonest hedge plants in India.

Shortening of internodes as an after-effect of GA treatment recorded in *Zinnia elegans* in the present investigation and also in *Sesamum indicum*¹ and *Cicer*

1. Chakravarti, S. C. *Phyton* 11 : 75 (1958).

*arietinum*² might result from a diminution in the rate of synthesis of growth

2. ———— *Nature* 182 : 1612 (1958).

factors as several investigators have found that GA fails to produce extension growth when the natural supply of auxins are cut off through decapitation.

144. The action of Alpha-Naphthalene acetic acid on the rate of growth of *Cicer arietinum* L.

S. NAIK, Sambalpur.

With a view to investigate the effect of growth promoting substances on the rate of growth of *Cicer arietinum* L., experiments were performed with A-Naphthalene acetic acid.

Fresh seeds were treated with the hormone in watery solution at various concentrations ranging from 1 ppm. to 10 ppm. The period of soaking of the seeds was 6, 12 and 18 hours respectively at 30°C. The hormone treated seeds were sown separately in different pots containing identical soil. Weekly records for the growth in heights of different plants were taken and the mean rate of increase in height during the week was determined.

The results show that A-Naphthalene acetic acid has got growth promoting effect on *Cicer arietinum* L. The rate of growth is affected by the concentration of the hormone solution. As the doses are lessened the growth becomes more and more pronounced. So the lower the concentration the higher is the rate of growth. It also shows that the growth hormone is effective even in very low dilutions and probably the inhibition becomes more and more pronounced leading to the eventual suppression of normal growth.

145. Studies on the Growth Hormone Contents of the Immature Kernels of a Local Variety of *Zea Mays*.

D. D. SABNIS and B. S. NAVALKAR, Bombay.

Work was carried out in this laboratory on the analysis of the growth hormones present in the immature seeds of a local variety of *Zea mays*. Total auxin was extracted after alkaline hydrolysis (N/50 NaOH at 15 lbs. pressure) and the sodium bicarbonate method of purification was employed. The auxins were isolated

and identified by using strip paper chromatographic technique. Only indoleacetic acid was detected in the acid fraction of the extract. Neutral hormones were not present in detectable quantities. Destruction of indoleacetic acid occurs in unpurified auxin extracts. Minor modifications in experimental technique are described. Further work is in progress. •

146. Effect of certain auxin-antagonisers on the rooting response of some stem cuttings with distinctive anatomy.

B. SAMANTARAI and H. PATTNAIK, Cuttack.

Stem cuttings of *Lepladenia reticulata* W. & A. were treated with aqueous solutions of β -indolyl butyric acid (IBA), Maleic hydrazide (MH), Tri-iodo-benzoic acid (TIBA), 2, 4-Dichloroanisole (DCA), IBA+MH, IBA+TIBA and IBA+DCA. The concentration of IBA was 100 parts per million (PPM.) as it was found to be the optimal concentration for rooting response for these twigs. The concentration of MH, TIBA and DCA applied were 100, 50 and 20 ppm. Controls were kept in water. The treatments lasted for 24 hours and subsequently the cuttings were washed and cultured in tap water under humid conditions and diffused light in propagating chambers.

It was found that the cuttings treated with IBA produced copious roots whereas those treated with MH, TIBA and DCA had no roots at all. However, cuttings treated with IBA and subsequently with lower concentrations of MH, TIBA and DCA respectively, produced few roots. This loss in rooting response is ascribed to the inhibitory effect of the auxin-antagonisers on the formation of root primordia.

147. Growth Regulating Properties of the Root Extract of Water Hyacinth. (*Eichornia speciosa*, Kunth).

S. M. SIRCAR and MAYA KUNDU, Calcutta.

The root extract of water hyacinth (*Eichornia speciosa*, Kunth) shows growth regulating properties. The aqueous extract in cold was found to have accelerated shoot growth and inhibition of root growth of several varieties of rice, oat, wheat, maize, gram, ground nut and mustard. A comparison of the effects of the extracts with those of IAA and GA indicates that the growth manifestations by the application of the root extract are not identical with IAA and GA. The results indicate the presence of a different type of growth promoting substance or substances present in the roots of water hyacinth for which chromatographic separation and chemical methods for identification have been in progress in this laboratory.

148. Effect of NAA on Sprout Inhibition of Potato Tubers.

B. D. BAIJLAL, Agra, and I. M. RAO, Tirupathi.

Influence of prestorage soaking of potato tubers (Var. Military special) in 0, 100 and 200 ppm. of NAA for 24 hours on loss in weight and sprout formation during storage have been investigated. Two bags, each with ten tubers, were kept for each treatment, including the control (tubers untreated). Observation on total loss in weight during storage for 123 days, and number and weight of sprout were recorded.

It is indicated that prestorage soaking treatments either in water or NAA led to decrease in the number of sprouts and also their weights ; but loss in weight

of the tubers during storage period was practically the same as in control. Decrease in number of sprouts relatively lowered with 100 ppm. of NAA (59.5% inhibition), compared to water-soaking (72.1% inhibition) or soaking in 200 ppm. of NAA (73.7% inhibition) ; however, the sprout-weight was depressed almost equally with the two concentrations of NAA (70.4% and 72.6% with 100 and 200 ppm. respectively) and was higher than that with water soaking (56.6%). The results of the present investigation are in the lines with the finding of the other workers.

149. Effects of Gibberellic Acid on the Flowering and Growth of an early rice.

G. MISRA and G. SAHU, Cuttack.

The effects of Gibberellic acid was studied on an early variety of rice, N.136. The treatment consisted of pre-sowing seed soaking for 72 hours followed by a post-sowing foliar spray with varying concentrations, 1, 10, 100, 250, and 500 parts per million (ppm.) of gibberellic acid. The spraying commenced with 28 days old seedlings and continued once a week till the time of ear emergence. Gibberellic acid in all concentrations induced a significant earliness in flowering in the treated plants in comparison with the controls, the maximum earliness being obtained with 100 ppm. of the chemical. Concentrations higher or lower than 100 ppm. produced a lesser degree of earliness. Gibberellic acid further brought about a decrease in the production of tillers and leaves along with a conspicuous elongation of the main shoot and tillers in comparison with the controls. The promotion or inhibition with regard to the vegetative characters strictly follows the concentration gradient of the chemical within the range 1 to 500 ppm.

150. Effects of Gibberellic Acid on the Radiation Stunted Seedlings of Maize.

B. K. GAUR and N. K. NOTANI, Trombay.

Maize seeds of the single cross WF 9×38-11 were irradiated with pile neutrons with doses ranging from 1×10^{13} Np to 5×10^{14} Np and then treated with Gibberellic Acid (GA). In one set of experiments the seeds were soaked in GA for 24 hours and then seedlings raised in sand. In the other set, seeds were sprouted on moistened filter papers and the selected seedlings with a 2-3 cm. root-length were from then on grown in GA solution. It was evident from both these experiments that GA can reverse the stunting of seedlings caused by radiation.

151. Relative Effectiveness of the Three Forms of Aminobenzoic Acid in the Flowering Behaviour of an Early Rice.

D. MISHRA and G. MISRA, Cuttack.

The effects of ortho, meta and para aminobenzoic acid on the flowering behaviour of an early variety of rice has been studied in pot culture experiments. The treatment consisted of soaking the homozygous pure seeds of the variety N.136 for 48 hours with each of these chemicals at the concentrations of 1, 10, 100 and 1,000 parts per million (ppm.) followed later on from 28th day old seedlings with a weekly foliar spray with the corresponding solution in which the seeds were previously soaked. The spraying was terminated at heading. A set of grains soaked in distilled water was maintained as controls. Of the three forms of aminobenzoic acid the meta acid brought about significant earlier ear emergence

over those of the controls at all the concentrations used. The ortho form is less effective than the meta one in that it induced earlier ear emergence at all the concentrations excepting at the highest one of 1,000 ppm. The para acid exhibited the least effect in that there was earlier ear emergence only at 1,000 ppm. Hence it is concluded that the three forms of aminobenzoic acid have a promotive effect on flowering of rice and that the degree of earliness depends on the relative position of the carboxyl group with respect to amino group in the molecule, maximum earliness being obtained with the meta form and minimum with the para one.

152. Physiological studies in salt tolerance of crop plants. VIII. Influence of IAA spraying on the deleterious effect of sodium sulphate on growth and maturity of wheat.

M. N. SARIN, Agra, and I. M. RAO, Tirupathi.

Local saline and alkaline soils contain a fairly large amount of sodium sulphate, even upto 0.269% (on oven-dry-soil). Depression in crop growth or even complete failure is of common occurrence in these areas. The present study was undertaken to evaluate the possibility of neutralising the sulphate injury by spraying the plants with IAA solution.

Seeds of wheat C.591 were sown in the first week of November in earthen pots containing air-dry soil mixed with compost (1 : 1). Two sets of two series were maintained : (i) with sodium sulphate (0.15% on air-dry-weight of the soil) added to the soil, (ii) normal soil without any added sulphate. Four weeks after sowing, one of the sets was subjected to weekly sprays of 5 ppm. solution of IAA and the spraying was continued till maturity. The experiment was conducted during two years, i.e. rabi 1956-57 and 1957-58.

Sodium sulphate retarded the growth and maturity of wheat plants but the yield of grain appeared to suffer more than the shoot-dry-matter production ; the average reduction in shoot-dry-weight and yield of grain for the two years amounted to nearly 33% and 42% respectively.

Spraying the wheat plants by IAA solution increased on an average the shoot-dry-weight by 38% but scarcely affected the yield when the plants were growing in normal soil. In the sodium sulphate added soil, however, IAA spraying increased significantly shoot-dry-weight and grain-yield of plants by 128% and 109% respectively over the unsprayed set ; further, IAA-sprayed plants, grown in sulphate soil, showed even better growth and yield than the unsprayed ones in the normal soil, the average increase in shoot-dry-weight and yield of grain being 53% and 11%. It clearly showed the utility of IAA-treatment to overcome the inhibitive effect of sodium sulphate on growth and maturity of wheat plants.

The various probabilities of the mechanism of salt injury are discussed and the use of synthetic phytohormones in crop-husbandry in salt lands is advocated.

153. Factors concerned in the secondary growth in the petioles of *Tridax procumbens* L. leaves.

B. SAMANTARAI and T. KABI, Cuttack.

The factors concerned in the secondary growth, were studied in the leaves of *Tridax procumbens*, where secondary growth was not observed when the leaves were attached to the plant. Profuse secondary growth was observed when the leaves were isolated and treated with synthetic hormones. Experiments were per-

formed with isolated leaves and attached leaves, with girdles above and below the node and without girdles. Synthetic hormones like β -indolyl butyric acid (IBA), β -indolyl acetic acid (IAA), and α -Naphthyl acetic (NAA) and auxin antagonisers like Maleic hydrazide (MII), Phenyl mercuric nitrate (PMN) and 2, 4-Dichloranisole (DCA) were used. The effect of some food stuff like sucrose and asparagine and some 'B' vitamins like thiamine, riboflavin and nicotinic acid was also studied. It was found that auxins whether native or applied enhanced secondary growth, auxin antagonisers inhibited secondary growth either partially or completely under different conditions and food stuffs and 'B' vitamins had no effect on the initiation and activation of the cambium. It is suggested from the experimental results that auxins whether native or synthetic control the initiation and activation of the cambium resulting in secondary growth.

154. Factors concerned in secondary growth in the petioles of woody climbers.

B. SAMANTARAI and B. K. NANDA, Cuttack.

Investigations were carried out to determine the factors concerned in the secondary growth in the petioles of *Argyrcia speciosa* Swcet. where secondary growth normally occurs when the leaves are attached to the plant. Before any cambium was formed in the leaves they were isolated and treated with β -indolyl butyric acid (IBA). Such leaves produced roots and secondary growth. The type of secondary growth in early stages resembled the normal type of secondary growth as seen under attached condition. During later stages it resembled the type seen in stems of this plant.

Administration of auxin-antagonisers Maleic hydrazide (MII) and Phenyl mercuric nitrate (PMN) once each, lowered down the magnitude of secondary growth. Repeated applications of these completely inhibited secondary growth. These auxin-antagonisers, however, along with IBA although reduced secondary growth, could not completely inhibit it even under repeated administration. It is suggested from the effects of auxin and their inactivation by auxin-antagonisers that auxins are solely responsible for the secondary growth occurring in petioles. Further the nature of secondary growth also lends support to the partial shoot theory of the leaf as elaborated by Arber.

155. Effect of Feeding Krebs Cycle Acids on the Respiration of *Kalanchoe* Sp.

P. V. V. SESHAGIRI and P. V. SUBBA RAO, Waltair.

The influence of different Krebs cycle acids on the respiratory mechanism of *Kalanchoe* leaves has been studied. In the course of the investigation it has been observed that age of the leaf and diurnal fluctuations have a marked influence on the rate of respiration and the respiratory quotient of the leaves. Chromatographic analyses of the leaves at different periods of the day have clearly indicated that there is an appreciable accumulation of malic and citric acids during the morning hours while a considerable depletion has been observed in the late hours of the day. Experiments on the feeding of the leaf tissue with pyruvate, succinate, fumarate or malate in varying concentrations either singly or in mixtures showed that oxygen uptake was accelerated by these acids while with citrate there was an inhibition. Carbon dioxide output was also found to be more pronounced when the tissue was fed with succinate, fumarate or malate while with citrate and pyruvate there was a marked lowering. In the light of the above findings it has been suggested that normal Krebs cycle changes are operative in *Kalanchoe* leaves, although certain reactions of the cycle are more pronounced than the others.

156. Influence of Temperature on the Distribution of Ascorbic Acid Content in Non-dormant Potato Tubers.

B. D. BAIJAL, Agra and I. M. RAO, Tirupathi.

The influence of temperature on the distribution of Ascorbic acid (Vitamin C) of the potato tubers (var. Military special) at regions 'near the eye' and 'away from the eye' has been investigated. On initiation of sprouting, the tubers were divided into two lots; one lot was kept in a local cold storage factory (temp. 34°F.) and the other one in room (temp. 85°F.) in darkness. Biweekly estimations for Ascorbic acid were made in duplicates, following the Indophenol Titration method (A.O.A.C. methods 1951).

It is observed that :

(i) Ascorbic acid content of the tubers were relatively higher in the room as compared to those in the cold-storage.

(ii) Ascorbic acid content were relatively higher in the regions 'away from the eye'.

(iii) Further, periodical fluctuations were quite conspicuous in both the regions under the two conditions of storage, more so in the regions 'near the eye'. Fluctuations in the regions 'near the eye' were more marked when the tubers were stored in the room than in the cold-storage.

Thus it is clear that during storage the temperature influences the distribution of Ascorbic acid content of the non-dormant tubers considerably. Periodical marked decreases in Ascorbic acid content near the sprout are discernible, apparently being due to its utilization in sprout formation. The work on the above problem is still under progress.

157. Studies in the Physiology of Fruits and Vegetables. VII. Physiological changes during ripening and storage of tomato in normal and low temperature.

J. K. CHOUDHURY and D. K. DAS GUPTA, Calcutta.

Tomatoes (var. *Patharkuchi*) were collected from Bhangur (near Calcutta) during the winter of 1958-59 and were kept at normal room temperature (72°–88°F, R.H. 33–97%), 50°–52°F (R.H. 70–75%) and 40°–42°F (R.H. 70–75%) to determine their loss in weight, keeping quality and chemical changes in respect of Vitamin-C (Ascorbic Acid), pH and total acid, alcohol soluble and insoluble solids total and reducing sugars and respiration rate during storage and ripening.

The fruits ripened and remained marketable for 8–9 and 21–24 days, respectively, at room temperature and 50°–52°F. At 40°–52°F they remained green for nearly three weeks without visible injury.

The fruits lost more in weight higher the temperature was but their ascorbic acid content was inversely related with temperature conditions. The average ascorbic acid values in the three temperatures, respectively, were 23.97, 24.71 and 27.49 mgm/100 gm. fresh material.

Total acids generally increased with the storage period in all temperatures and the pH decreased, except in 40°–42°F, where the pH did not change. Total acid (as \equiv (N) NaOH) under the storage conditions, respectively, were 8.06, 7.88 and 7.79 c.c., on an average, in 100 gms. fresh material.

Sugars in tomatoes were present mainly as non-reducing sugar which did not change to any appreciable extent under storage conditions. A very small quantity of non-reducing substance, however, appeared for a short period after 2–3 days in storage, particularly under room temperature. Reducing sugar, on an average,

was 1.93, 2.08 and 2.16 gms/100 gms. fresh material under the three storage conditions. Alcohol soluble and insoluble matters did not show any significant change during storage.

Respiration rate gradually decreased after the maximum climatic rise on the third day of storage. Average CO_2 evolved was 5.51 mg./100 gm. tomato at $35.5^\circ \pm 0.5^\circ\text{C}$.

158. Interaction of Potassium and Cobalt with Auxins on Flowering of Early Rice.

D. MISHRA and G. MISRA, Cuttack.

The effect of potassium chloride, cobalt chloride at the concentrations of 1000 ppm. (parts per million), IAA and NAA at the concentrations of 100 ppm. and the combination of these inorganic chemicals with auxins has been investigated on the ear emergence of two early varieties of rice N. 136 and B. 76, in pot culture experiments. The treatment consisted of soaking the seeds in the respective solutions for 48 hours followed with a foliar spray with the corresponding solution in which the seeds were initially soaked. The spraying was given once a week beginning with 28-day-old plants till panicle emergence in the individual plants. A set soaked in distilled water served as control. All the treatments excepting two produced a significant earliness in ear emergence. Potassium chloride in combination with IAA produced the maximum earliness. Next in a descending order followed the treatments IAA, Potassium chloride plus NAA, cobalt chloride plus IAA, potassium chloride plus cobalt chloride, potassium chloride, and cobalt chloride plus NAA. NAA alone did not produce any significant change from the controls. Cobalt chloride alone produced, on the other hand, a reverse effect of delay in ear emergence. The point of interest is that the delaying effect by cobalt chloride is negated when IAA, NAA or potassium chloride is applied in combination with it. A combination of potassium chloride and auxins exerted a synergistic or more favourable influence on the ear emergence than potassium chloride or auxins treated alone.

159. Antagonism between sulphanilamide and p-aminobenzoic acid in flowering of an early rice.

D. MISHRA and G. MISRA, Cuttack.

Sulphanilamide and p-aminobenzoic acid have been reported to have marked physiological role on plant growth, particularly that of roots. The antagonistic action of p-aminobenzoic acid on sulphanilamide inhibition seems open to some doubt. This experiment was designed to test the possible antagonistic effect of p-aminobenzoic acid with sulphanilamide in so far as the flowering behaviour of rice is concerned. Graded seeds of an early variety of rice, N. 136 were soaked for 48 hours separately with sulphanilamide and p-aminobenzoic acid at the concentrations of 1, 10, 100 and 1000 parts per million (ppm) and in another experiment with a mixture of the two chemicals at different concentrations. After a thorough wash in water the seeds were sown in seed bed pots and later the seedlings were transplanted to bigger earthenware pots. A set of grains soaked in distilled water served as controls. The plants were then subjected to a foliar spray with corresponding solution in which the seeds were initially soaked. The spraying was commenced with 4-week-old plants and was continued once a week up to heading. Sulphanilamide at higher concentrations brought about a slight delay while p-aminobenzoic acid at the highest concentration of 1000 ppm produced the

reverse effect of slight earliness in ear emergence. The interesting point is that when p-aminobenzoic acid was applied in combination with sulphanilamide, the inhibiting effect of sulphanilamide was greatly diluted and was no longer statistically significant. Hence p-aminobenzoic acid had definite antagonistic effect on the inhibition caused by higher concentrations of sulphanilamide.

160. Response of the root growth in *Allium cepa* to Coumarin.

S. N. PATNAIK, Cuttack.

The inhibitory effect of Coumarin and several other unsaturated lactones have been reported. The expansion of leaf lamina and the accelerating effect on the growth of the roots were also previously reported. The effect of various concentrations such as 0.1, 1, 10, 100 and 1000 parts per million (ppm.) on the growth of the roots of onion bulbs has been studied. The bulbs were selected for uniformity of size and treated for 72 hours by placing them over specimen tubes filled with the solution. Another set treated with distilled water served as the control. Six replications were maintained for each treatment. The bulbs after treatment were thoroughly washed and were allowed to grow over specimen tubes filled with tap water in a dark chamber at room temperature. Observations were recorded on the number and the mean length of the roots commencing from fifth day of the treatment till the 15th day at an interval of two days. Finally the fresh weight of all the roots per bulb was determined. The results indicated that very high concentrations such as 100 and 1000 ppm. had conspicuous inhibiting effect on the growth of the roots, though this was gradually reduced with the advancement of the age. The lower concentrations behaved differently. Very low concentrations such as 0.1 ppm. had no significant effect but 1 ppm. had prominent accelerating effect on the growth of the roots which persisted upto 10 ppm. though the effect was significantly decreased. Thus two things were clear from the behaviour of Coumarin on the growth of the roots of onion bulbs. Firstly the high concentrations such as 100 and 1000 ppm. have inhibiting effect and that is in their increased order of gradations and secondly there is an accelerating effect at optimum low concentration.

161. The influence of time of flowering on growth of *Cicer arietinum* var. N. P. 9.

K. K. NANDA and J. J. CHINYOY, Delhi.

Unvernalized (C) and vernalized (V) seedlings of gram were exposed to (1) Short Day (SD), (2) Normal Day (ND), (3) Long Day of 18 hour illumination (18-LD) and (4) Long Day of 24 hour daily illumination (24-LD) and the effect of these treatments on stem growth, number of branches and leaves per plant and number of leaves per branch was studied in relation to the vegetative period.

The rate of stem elongation is higher in LD plants and reaches an earlier maximum than in ND ones. This earliness is more in 24-LD (C) plants than in 18-LD (C) ones. The rate in ND (C) and SD (C) plants is slower but stem elongation continues for a longer period in these cases. Vernalization hastens stem elongation so that an earlier maximum is reached in vernalized plants as compared with the unvernallized ones under the respective photoperiodic treatment.

A highly significant positive correlation between the vegetative period and the period of attainment of maximum height shows that the effect of these treatments on stem growth is probably due to the acceleration or retardation in flowering that is caused by them.

Longer photoperiods suppress the production of branches and leaves. This suppression is more in 24-LD (C) plants than in 18-LD (C) ones. In SD (C) plants also the rate of production of branches and leaves is much lower than in ND (C) plants. Vernalization also results in suppression of branches.

The reason for the suppression of branches and leaves is a direct one in the case of SD (C) plants resulting from its low assimilatory activity while, on the other hand, it is an indirect one in the case of LD (C) and vernalized plants operating through regulatory mechanism of its developmental process.

162. Phasic Development of *Cicer arietinum* in relation to its Photo and Thermic Quanta.

K. K. NANDA and J. J. CHINYOY, Delhi.

Seeds of a pure line variety of gram—*Cicer arietinum* var. 9-- were vernalized for 45 days (V) and were sown in earthen pots along with the unvernallized set (C). These were, then, exposed to photoperiodic treatments consisting of Short Days (6 hour), Normal Days (about 11 hour) and Long Days of 18 and 24 hours of illumination, and their effects on vegetative period (number of days from the date of transplantation to the dates of bud initiation and flower opening) were studied. The total number of light hours (Photo Quantum) as well as the sum of the mean diurnal temperatures (Thermic Quantum) up to the stages of bud initiation and flower opening were calculated for plants under different treatment combinations. Regression of the logarithms of photo quantum on the logarithms of thermic quantum upto these two well marked stages were determined separately for vernalized and unvernallized plants.

There is inverse correlation between the photo quantum and the thermic quantum upto the stage of bud initiation in the case of unvernallized plants. In vernalized plants, however, there is a great divergence of the statistically computed values from the experimental values. The bud initiation is accelerated by low temperature during germination (vernalization) irrespective of the photoperiod to which plants are exposed subsequently. The effect of light and temperature appears to be complimentary upto this stage.

The period of flower development (the period between the stages of bud initiation and flower opening) is, however, mainly determined by the photoperiod. This confirms the existence of the gametogenetic phase postulated previously (Nanda and Chinoy, 1945; 1957) in the case of wheat.

A close inverse correlation between the photo and thermic quanta is found for the vegetative period upto the stage of flower opening both for vernalized and unvernallized plants. This shows that the photothermic concept is not incompatible with the phasic development of this plant inspite of the fact that the energy required for the completion of a given phase may be supplied either in the photo or thermic form.

163. Studies on the Effect of Light on Growth of Seedlings. I. The Effect of Photoperiods on Elongation of Rice Embryos.

T. M. DAS and ILABANTA MUKHERJEE, Calcutta.

In the experiment for culture of rice embryos it has been revealed that elongation of rice embryos may be controlled by periodicity of light.

Rice grain variety *Rupsail* are grown in cylindrical glass vessels. During the experiment, treatments are divided into 3 sets. In the first set, roots are kept in constant darkness while only shoots are treated with different photo-periods. In

the second set, roots and shoots both are exposed to the different photo-periods simultaneously. And in the third set, shoots are kept in constant darkness and only roots are treated with different photoperiods. The following photoperiods are given :—(1) Continuous light, (2) 24 hours light+5 minutes darkness, (3) 19 hours light+5 hours darkness, (4) 19 hours darkness+5 hours light, (5) 24 hours darkness+5 minutes light, (6) Continuous darkness. The experiment was carried out for 116 hours after which the length of coleoptile, leaf, root was recorded to the nearest millimetre.

In general, growth of the coleoptile is retarded with the increase of duration of light. It is interesting to note that the maximum reduction of coleoptilar length does not coincide with the continuous application of light, but on the other hand the maximum reduction of coleoptilar length is found when the photoperiod is followed by a brief period of darkness. This finding obviously indicates the relative significance of darkness in growth reaction of the plant. When roots or shoots are treated with photoperiods, the effect is found to be migrated to the other parts of the plant. The nature of the growth that is found under periodic exposures to light is specific, and entirely different from that found under exposure to total amount of light and dark.

164. Studies on the Effect of Light on growth of Seedlings—III. The effect of light on translocation of hydrolysed substances from endosperm to embryo and increase of dry weight in rice seedlings.

T. M. DAS and JOTINDRA MOHAN CHOUDDHURI, Calcutta.

It is a well known fact that elongation of the coleoptile is favoured in darkness and it is understood that the greater rate of elongation of coleoptilar cells in darkness is caused by the action of auxin.

In the present investigation rice seeds variety *Rupsail* were germinated under continuous darkness and light of different periodicities in a temperature and light controlled room. At the end of 116 hours of growth, the dry weight and the length of different parts of the seedlings viz., coleoptile, root, leaf and endosperm were estimated. It is interesting to note that a greater elongation of the coleoptile under continuous darkness was always associated with greater accumulation of dry-matter with corresponding greater loss of dry-matter from the endosperm. Low intensity of light (150 F.C.), either continuous or periodically exposed, significantly inhibited the translocation of hydrolysed matter from endosperm to the embryo, and also reduced the dry weight accumulation in the coleoptilar tissue.

Behaviour of the leaf tissue was somewhat different. The rice leaf generally breaks open through coleoptile after 72 hours of growth, after which the accumulation of dry matter in leaf was favoured in light; which suggests that, from physiological point of view, coleoptilar tissue is rather different organ from that of leaf and it cannot be regarded as the first leaf of the embryo.

165. Chemical Vernalisation in an Early Variety of Rice.

G. MISRA and G. SAHU, Cuttack.

The effects of three plant growth substances, β -indolylacetic acid (IAA), α -naphthylacetic acid (NAA) and Triiodobenzoic acid (TIBA) individually and in combination with low temperature (3°C.) has been studied on the growth and flowering of an early variety of rice, N. 136, in pot-culture experiment. The treatment consisted of soaking the seeds for 72 hours with 1,10,000, and 500 parts per million (ppm) of each of the three plant growth substances in one series and

seed soaking followed by the low temperature treatment for a fortnight in another series. A set of seeds soaked simply in distilled water served as the controls. The seeds in all the sets were sown in seed bed pots on the same date and at the age of 21 days they were transplanted to 10" earthenware pots containing soil and cow-dung manure in the proportion of 8:1. Of the plant growth substances, IAA and TIBA alone did not produce any significant changes from the control whereas NAA alone at high concentrations of 500 and 100 ppm. produced a significant delay in flowering. In all the sets where the seeds received a combined treatment of the plant growth substances and the low temperature vernalisation, there was comparatively earlier ear emergence in comparison to the sets which received the chemical treatments alone. Furthermore, the combination of low temperature and chemicals brought about a greater production of tillers and leaves than the chemicals alone. Hence the chemical vernalisation in rice shows some positive results.

166. Drought Resistance in Wheat.

J. J. CHINYOY, Delhi.

Physiological studies of drought resistance in wheat have been undertaken by the writer during the last eighteen years, from April, 1941 to July, 1947 at the Indian Agricultural Research Institute New Delhi, and subsequently at the University of Delhi. Work has proceeded along the following lines: (1) Study of wheat collection under irrigated and 'dry' conditions; (2) Determination of varietal resistance to wilting at different stages of growth and development; (3) Determination of varietal resistance to wilting after synchronization of growth and developmental stages by giving vernalization and photoperiodic treatments; (4) Pre-sowing hardening treatment of seed of crop plants with a view to determining its agrobiological value for Indian conditions; (5) Study of protoplasmic factors determining drought resistance.

Growth and yield behaviour of 260 varieties of wheat has revealed highly significant inverse correlations between grain yield and 1000 kernel weight on the one hand and the mean maximum temperature of the ripening period on the other. These correlations have been confirmed not only by altering their time of flowering so as to synchronize their ripening periods with either a lower or higher range of temperature, but also by experiments on the ontogeny of wheat grain.

Wilting experiments have shown that all the varieties tested so far are drought resistant during the tillering phase. Wilting at the shooting and the flowering stages is injurious in the case of all the varieties, the degree of drought damage depending upon the time of flowering. Late varieties were more susceptible to drought on account of the higher prevailing temperature during their shooting and flowering stages. When the shooting and the flowering stages of these late varieties were shifted to a lower temperature range by vernalization and photoperiodic treatments the damaging effect of wilting during these stages was eliminated to a considerable extent and all varieties responded uniformly to drought.

Pre-sowing hardening treatment of seed enhanced the rate of germination and seedling growth by increasing its water absorbing capacity, as well as mobilising the reserve food of the seed at a faster rate.

Study of protoplasmic factors reveal that higher hydration of the colloids and greater permeability are associated with the phenomenon of resistance.

167. Role of food factors like sugar and asparagine on the rooting response of isolated leaves.

B. SAMANTARAI and P. C. TRIPATHY, Cuttack.

A preliminary study has been made to ascertain how far sugar and asparagine are responsible for the origin of roots in isolated leaves. Leaves of *Daedala-canthus splendens* T. Anders. were fed with aqueous solutions of sucrose, asparagine and β -indolyl butyric acid (IBA) separately or together as mixtures and then MH solution were administered in aqueous solutions. It is seen that in the absence of MH, sucrose and asparagine enhance rooting response whereas in presence of MH there is a considerable reduction of this process and with repeated application of MH there is a complete inhibition of root production. It is suggested that sugars and asparagine do not possess the faculty of originating roots, which is controlled either by native or applied hormones, but they exert an enhancing effect by supplying necessary food for the growth of the roots formed due to the action of hormones.

168. Studies in the Physiology of Fruits and Vegetables. VIII. Interaction of Temperatures on the Storage and Ripening behaviour of Tomato.

J. K. CHOUHDURY and D. K. DAS GUPTA, Calcutta.

Green mature tomatoes (Var. *Patharkuchi*) were gathered from Bhangur (near Calcutta) during the winter of 1958-59 and were stored for varying periods in three temperatures,—viz. (i) room temperature (72° – 88° F, R.H. 33–97%), (ii) 50° – 52° F (R.H. 70–75%) and 40° – 42° F (R.H. 70–75%), with a view to study the interaction of these temperatures on their storage and ripening behaviour (particularly the development of red colour).

While the fruits could be preserved by keeping them all along in these three temperatures for the maximum periods of 9, 24 and 21 days, respectively, they could be preserved for 3 to 5 weeks in a number of temperature combinations, e.g., by keeping them in 50° – 52° F for 7–14 days and then in 40° – 42° F (total storage period was 33-34 days).

In 50° – 52° F the fruits ripened and developed full red colour but the metabolic processes leading to ripening and development of colour was suppressed in 40° – 52° F. In some cases it also appeared that these processes, while in progress for a short period on higher temperature as indicated by colouring, was checked when the fruits were transferred to low temperature (e.g., from room temperature to 40° – 42° F). On the other hand, there were also some indications that if the fruits were yellowing and turning red in higher temperature, these processes remained unchecked when the fruits were transferred to low temperature, provided the difference in the two storage temperatures were not wide enough (e.g. from 50° – 52° F to 40° – 42° F).

169. Studies in the Phosphorus fractionation in some edible leaves of plants Grown in Bombay and its Suburbs. Part—I. (*Amarantus polygamus* L., *A. tennifolius* Willd., *Apium graveolens* L., *Brassica oleracea*, var. *botrytis*, L. and *B. oleracea*, var. *capitata* L.).

(Smt.) KARKAL, MALINI and NAVALKAR, B. S., Bombay.

The investigations on phosphorus content was carried out on some 20 leafy vegetables of every day use in Bombay, like Radish, Celergy, Foxtail, Phulkobi, Kobi, Lal-Math, etc.

Nitric-perchloric acid digestion as recommended by Hardin *et al* was used for total Phosphorus determination. Acid-soluble phosphorus was extracted in 10% Trichloroacetic acid and digested with nitric acid. Lipid Phosphorus was extracted with ether-ethanol mixture. Inorganic phosphorus was extracted with Trichloroacetic acid and this extract was used directly. The phosphorus content was determined colorimetrically according to A.O.A.C. procedure.

All plants were collected from the same locality to minimize the difference in environmental factors. The results showed that the plants were sufficiently rich in their phosphorus contents (170.6—3676.26 mg./100 gm.) and could be ordinarily used even by economically lower groups in society to keep up the nutritive balance of Phosphorus in their every-day diet. The moisture content was very high varying from 76.20% to 94.12%. Further the conclusions drawn from the laboratory tests can serve only as a rough guide.

170. The Effects of Beta Radiation from Radiophosphorus on Emergence and Growth of Seedlings in Rice.

A. K. BASU and A. K. ROY CHOWDHURY, Calcutta.

The effects of beta radiation from radiophosphorus (P^{32}) on the emergence and growth of seedlings in rice were studied. The seeds of *Rupsail*, a pure line winter variety of rice, *Oryza sativa* L. were treated with 0.5, 1.0 and 1.5 millicurie initial activities of P^{32} for 42 hours. The treated seeds and the untreated were sown in the field in a randomised block layout of five replications. The total number of seedlings emerged in each treatment were noted after 14 days of sowing, due consideration being given to the mortality of the seedlings during the intervening period. To determine the degree of inhibition after radiation the seedlings were measured after 30 days of sowing.

When the percentage of emergence of seedling is analysed statistically, it is observed that variation due to treatments is highly significant and the fall of the percentage of emergence of seedlings is proportional to the dose of radiophosphorus. It is further noted that the difference in percentages between two treatments is not significant when the difference in doses is only 0.5 millicurie but if it is 1.0 millicurie or more the difference in percentage is significant even at 1% level. As regards the length of the 30 day-old seedlings, there has been inhibition in two treatments but they are not statistically significant.

171. Effect of moisture on Radio-Sensitivity.

ARUN KUMAR SHARMA and CHITRA TALUKDAR, Calcutta.

In order to study the effect of moisture on the manifestation of X-ray action, seeds of *Vicia sativa* Linn. were treated in two ways. Some seeds were pre-soaked in water prior to irradiation, while others were taken dry, irradiated and then allowed to germinate. In the former case, two separate sets were taken, those that were just germinating at the time of irradiation and those that had not yet germinated but were fully turgid. For pre-soaked seeds, X-radiations of 500r, 750r, 1000r, and 4000r were given and for each dosage two separate sets were used for observation, i.e. germinating and non-germinating seeds. Observations were made after every 24 hours for 14 successive days. For dry seeds only a dosage of 4000r was used and observations were made as for pre-soaked seeds.

The observations for each dosage showed chromosomal aberrations mainly in the form of sticky anaphase bridges, diplochromosomes fragments, pseudochiasmata etc. An interesting fact noticed was that moisture had no effect on either promoting or

demoting the frequency and nature of chromosomal aberration even with an increase in dosage. Moreover the fragments in most cases were two in number corresponding to the two satellites of the pair of chromosomes that had them, suggesting the chemical dissimilarity of the different heterochromatic regions situated on the chromosome. Fragments persisted up to 13 days. Since radiation damage here is not affected by moisture content, indications are that the mechanism of indirect action of radiation is not operative here.

172. The effect of Sound-percussions of Bharat-Natyam Dances transmitted through the earth on the growth and flowering of Gaillardia.

A. SRINIVASAN, Madras.

Encouraged by the experimental results of Singh & Stella-Ponniah on Marigold (Proc. 15th International Horticultural Congress Nice (France), 1958, pp. 84-85) experiments were undertaken in which *Gaillardia* plants were excited by the execution of Bharat-Natyam Dance from within a distance of 12 feet daily for 20 minutes towards evening for 60 days. It was observed that the sound-percussions of the dance transmitted through the earth had definite effect on the general vegetation growth performance and flowering of the experimental plants, namely: they were more vigorous in their vegetative growth performance with production of greater number of leaves to the extent of about 50% and induction of earlier flowering by at least seven days as compared to the control. These experimental results are in accord with the observations on Marigold. Further work is in progress.

173. On the effect of Sound-Waves on the Respiration of Germinating Seeds of Black Gram.

T. C. N. SINGH, Annamalaiagar.

Experiments on the effect of sound-waves on the respiration of germinating seeds have been done for the first time. In the process, germinating seeds of black-gram were excited by the sound-waves of an electric-bell by ringing it continuously for a period of *thirty minutes*. Therefore, the respiration values of these germinating seeds were determined through the use of Warburg Respiration Apparatus (Model V8). The values so obtained were contrasted and compared with those of the germinating seeds of black-gram not excited by any sound-waves with the help of the same apparatus. As a result it has been found that the respiration values of excited germinating seeds were definitely higher than those not excited by sound-waves. This conclusion further gains support from a statistical analysis of the data, showing that the values of the two critical differences both at the 5% and 1% levels were much lower than the mean observed difference in respiration. So the result obtained has been found to be statistically significant in favour of the germinating seeds excited by sound waves.

174. On the effect of sound-waves on the Carbon Assimilation of Chara.

S. PANNIRSELVAM, Annamalaiagar.

Recently it has been demonstrated by Singh in a paper communicated to the IX International Botanical Congress (Montreal) that the assimilation value of *Hydrilla verticillata* Presl. as judged from both the quantum and rate of the evolution of oxygen is enhanced under the excitation of the sound-waves of electric-bell. In the

present investigation a similar experiment was performed on another submerged water plant *Chara* which is the very first cryptogamic plant to be introduced to such an experiment under the excitation of sound-waves.

Two seeds of carbon-assimilation experiments with the usual classical funnel-test-tube apparatus were arranged in water with *Chara* in two separate rooms under artificial illumination of electric bulb of 100 Watt. and constant temperature of about 36°C. was maintained in both the sets. Out of these two, one set of the experiment was excited by ringing an electric bell near the surface of water for 30 minutes. As a result the evolution of oxygen in this set was very much enhanced to the extent of about 60% as compared to the control set-up which was not excited by sound-waves. This result has been obtained by performing several experiments which have been statistically analysed and have been found to be significant at both the 5% and 1% levels of significance.

175. On the Response of *Tagetes erecta* Linn. to the Musical Sound of Violin.

(Miss) STELLA PONNIAH, Tiruchirappalli.

Healthy seedlings of uniform vigour of *Tagetes erecta* (Marigold) were excited by the musical sounds of the *Karnatic raga Maya-malva-gaula* played on violin in the early hours of the morning for 25 minutes daily for a period of 14 weeks. Another set of seedlings of similar vigour and uniformity was maintained as control for the sake of comparison. For about 5 weeks there was hardly any visible difference between the experimental and control seedlings. But after the 6th week the control seedlings were outbeaten by the musically excited experimental seedlings; and at the end of the experiment namely after 14 weeks it was found that the average length of experimental plants was over 40% higher than that of the control but in leafiness the increase registered was of the order of 30%.

It is however significant to note that in the case of experimental plants as compared to the control, the flowering phase was delayed by 40 days. Out of quite a number of species of plants investigated in this laboratory, this is the only species where such a phenomenon has been recorded otherwise the musically sound excited plants enter into reproductive phase much earlier than the control.

176. A note on the effect of sound vibrations of Tuning Fork on the mitosis in Sweet Potato (*Ipomoea batatas* Lam.).

K. RANGASWAMI AYYANGAR, Annamalainagar.

Of late, work has been in progress in this laboratory on the effect of sound vibrations on the growth and reproductive phases of plants like *Mimosa*, *Desmodium*, *Cosmos*, *Tagetes*, *Impatiens*, *Angelonia*, *Allium*, *Manihot*, *Saccharum*, *Ipomoea* etc. The observations so far made have revealed the fact that both vegetative and reproductive developments are far better in the sound-treated plants than in the corresponding controls. It was, therefore, thought that the sound might have some influence on the cell division also. So two sets of *Ipomoea* plants of identical size were grown in pots maintaining other factors like soil and water also in an identical manner. Near one set of potted plants (at a distance of 3 feet) an electrically run Tuning Fork was set to produce sound vibrations at a frequency of 100. The other set of potted plants (the control) was kept far enough not to be affected by the sound of the Tuning Fork. Daily, the Tuning Fork treatment was given for 30 minutes and the growth was watched from time to time in both the experimental and control sets. Root tips from both the experimental and control plants were taken out and acetocarmine squashes were made according

to the technique developed here. It was observed that the number of cells undergoing mitotic division increased from 5% to 43% under the excitation by sound. The inference is that sound vibrations impinging on the protoplasm stimulate the otherwise quiescent nuclei to mitotic activity. As a matter of fact, in the *Hydrilla verticillata* Presl., it was definitely demonstrated that sound vibration caused more rapid streaming movement of the protoplasm of the cells. The phenomena of more vigorous growth already reported in the various plants which were bombarded by sound waves is to be attributed to the stimulation of the cell protoplasm into greater activity which results in more rapid and more frequent nuclear divisions and the consequent increased growth rate and augmented size of the plants concerned. It is common knowledge, that other forms of energy like U V rays, Infra-Red Rays, X-rays, influence nuclear division and even cause chromosomal aberrations. In a similar way, sound waves would appear to have the effect of accelerating mitosis in plants.

177. Effect of Sound-Waves of Nadeshwaram on the growth and yield of paddy.

T. C. N. SINGH and A. GNANAM, Annamalainagar.

The recent demonstration by Miss Stella-Ponniah of recorded musical sounds exciting *Pothos* plants into more vigorous growth, induced a field scale trial being taken up at Sirkali (Tanjore District) on transplanted paddy Co. 25 by broadcasting sound-waves of *Nadeshwaram* through an amplifier on a 5 acre plot. This broadcasting of sound-waves was done daily for 30 minutes in the early hours of the morning at 7 A.M. Another plot of about the same acreage transplanted with the very same variety of paddy namely Co. 25, was maintained as control far away from the experimental plot. The experiment was continued for two months. The performance of paddy crop in the experimental plot was far superior to that of the control as evidenced by the fact that the number of tillers per clump was 40% more, the height of plants and the length of spikes were respectively 23% and 30% greater, and the gross yield of grain and straw taken separately was over 60% higher than the control. Reading of this paper will be illustrated by magic lantern slides.

178. The effect of Sound-Waves of Violin on the growth and yield of tobacco (*Nicotian tabacum* Linn.)

T. C. N. SINGH and S. KRISHNAN, Annamalainagar.

This experiment is one of the first of the series under field-conditions of the cultivator in tobacco nursery at Sivapuri—a famous tobacco growing area in South India.

Tobacco seedlings in nursery were dosed daily for twenty-five minutes for 31 days with sound waves of violin. On the other hand a proper control nursery was regularly maintained with all precautions far away from the experimental nursery, seedlings of which were not dosed with any sound-waves.

As compared to the control seedlings the experimental ones were found to be sturdier and more vigorous in growth with more and stronger root system. Besides, the incidence of mortality was the least amongst the sound-dosed seedlings.

No sound-dosing was done after transplantation of the seedlings in the field. At the time of harvest for curing the leaves for purposes of chewing, it was observed that the adult experimental plants in general in their vertical height and horizontal spread were easily over 40% superior to those of the control; the leaves

in number (per plant), in thickness and even in size were superior with higher nicotin content. Remarkably enough the yield of cured tobacco leaves from the experimental plot was 45% higher than that of the control plot. In fact the sound-dosed cured tobacco leaves have proved to be the best in Sivapuri area both in yield and quality.

179. On the effect of Recorded Sound-waves of flute on the growth of *Pothos*.

(Miss) STELLA-PONNIAH, Tiruchirapalli.

The effect of recorded sound-waves on the growth of plants has been experimented for the first time. In doing so recorded *Kamboji raga* piped through flute by Shri T. R. Mahalingam (Bangalore) was played on gramophone for 30 minutes daily for a period of 30 days for exciting *Pothos* plants. As a result it was found that the average height of plants had increased by 25%, average number of roots by 100%, average number of leaves by 50% and average L X B of leaves by 30% over those of the control plants.

180. On the activation of photosynthesis in *Hydrilla verticillata* Presl. by sound waves of electric bell.

T. C. N. SINGH, Annamalainagar.

The common submerged *Hydrilla verticillata* Presl. plants during the process of photo-synthesis, were subjected to the excitation of sound waves of electric bell with proper controls. It has been found after a series of experiments that the rate and volume of oxygen evolved in sound excited plants during a particular period were higher than the control plants not dosed with sound, showing thereby that in sound excited plants synthesis and production of elaborated food was higher. The fuller paper will be illustrated with magic lantern slides.

181. Effect of Ultra-violet rays on the growth of rose cuttings.

G. LEELAKRISHNAN, Tirupati.

Rose cuttings were irradiated by ultra-violet rays for 5 minutes, 10 minutes and 15 minutes. Controls for each were kept. Observations were made periodically.

When the final observation was made it was noted with interest that all the irradiated rose cuttings showed vigorous growth. The vigour in growth according to the time of irradiation may be ranked as 15 minutes, 5 minutes and 10 minutes.

Apart from the vigorous growth of the experimental plants all the experimental plants were healthy on the final observation day and seemed to have resisted the attack of some disease which overtook the control plants and which resulted in the death of all the control plants.

182. Studies in seasonal flower-colour spectrum of plants.

T. C. N. SINGH and K. RAMAMURTHY, Annamalainagar.

Flower-colours (except white) of the Angiospermic flora of Annamalainagar have been observed and recorded from day-to-day during the last two years. The species so observed have been classified under the seven basic rainbow colours (viz, violet, blue, green, indigo, yellow, orange and red) based on their respective

flower-colours. In turn the species on seasonal basis have been classed under the following two-monthly groups:

October-November; December-January; February-March; April-May; June-July and August-September.

Seasonal flower-colour spectra have been drawn for each of the groups. In constructing these, frequency of species on percentage basis has alone been charted by the particular colour wash. On comparing these flower-colour spectra, it has been found that in this area red and yellow are the dominant flower-colours. Indigo flower-colour is totally absent. Red flower-colour has been found to be dominant in October-November, whereas Yellow dominates over other flower-colours during February-March. In June-July group alone there is a complete absence of green flower-colour. The other flower-colours namely Orange and Blue fluctuate within narrow percentage limits. The violet flower-colour however is practically constant in all the groups.

183. Studies on early seedling metabolism in Wheat.

S. N. BHARDWAJ, Agra.

Early seedling metabolism of wheat C. 591 (till 96 hours after sowing) has been investigated, with particular reference to respiration, respiratory quotient and seedling composition. Seedlings were raised in petri-dishes (12.5 cm. diam.), with filter paper, at 25°C. in darkness. Observations on respiration rate (QO_2 , as well as QCO_2), R.Q., fresh and dry-weight, hydration percentage and chemical composition (Total available carbohydrates, reducing and invert sugars, total- and protein-nitrogen, and fat content) of the seedlings were recorded at 24 hourly intervals. Presence of free sugars and amino-acids was detected chromatographically. Further, rate of respiration and R.Q. were also studied at short durations of 10 minutes for a period extending one hour, at each interval.

The results indicate that values for QO_2 were always higher than those for QCO_2 , thus R.Q. remained lower than unity. With progressive increase in seedling growth, loss in dry-weight was slight and very gradual upto the end of the experiment. Reducing and invert sugars and also protein-nitrogen showed increasing trends, while total-available carbohydrates were depleted continuously; total nitrogen and fat content were affected almost negligibly. Chromatographic estimations reveal that during the period of initial soaking (0–24 hour) a few of the sugars (Lactose and Maltose) and the amino-acids (Asparagine, Aspartic acid, Glycine or Serine, Histidine, Isoleucine, Lysine, Tryptophane or DL-Methionine, and DL-Valine) leach out completely, but are resynthesized during the next 24 hours of growth (i.e. upto 48 hours).

On the basis of the above findings, a possibility for the existence of oxidative anabolism during the period of active growth has been indicated.

184. Concentration of amino-acids in apical fragment of Control and Vernalised seedlings of Mustard T. 202 grown in different media.

B. SEN and D. K. VERMA, Almora.

Experiments were undertaken to find out the concentration of different amino-acids in the apical fragments of control and vernalised seedlings of mustard T. 102 grown in the following solutions: (a) glass distilled water, (b) White's nutrient solution, (v) 100 p.p.m. gibberellic acid and (d) White's nutrient solution containing 100 p.p.m. gibberellic acid. Descending chromatography was used for analysis of the different amino-acids (Consden *et al.*, 1944). Butanol, acetic acid

and water (40:10:50) was used as solvent (Giri, 1951) and 0.4% solution of ninhydrin in 95% acetone as colour reagent.

The method of R. N. Green Shields (1958) was used for spotting on the filter papers. Five apical fragments from each treatment were twice pressed directly on the filter paper between two glass slides, one placed over the fragments and the other below the filter paper, to extract all their liquid contents and to give a smear of about $\frac{1}{4}$ " diameter. After each smearing filter paper was dried in air for 30 seconds, and developed twice in the solvent. The areas of the spots developed have been taken as the indices of the concentration of aminoacids.

The chromatograms indicate that in all twelve spots developed, but the concentrations of various amino-acids varied and that :

Cystine content in the control fragments of seedlings grown in glass distilled water is the least and in the vernalised samples, the highest.

Lysine content is highest in control fragments grown in White's nutrient solution containing gibberellic acid and least in White's nutrient solution. Vernalised samples grown in gibberellic acid and glass distilled water show the highest content.

Citrulline contents of vernalised fragments isolated from all the treatments are higher than control samples.

Arginine : As regards arginine contents, there is no marked difference between the control and vernalised samples except in the case of those grown in White's nutrient solution. In control fragments, the highest content is in fragments grown in White's nutrient solution and the least in those grown in the gibberellic acid.

In vernalised fragments, the highest content is in those grown in White's nutrient solution.

Serine-Glycine : There is a marked increase in all fragments from vernalised seedlings except in the case of fragments grown in White's nutrient solution containing gibberellic acid.

Aspartic acid : Only in fragments grown in glass distilled water there is a marked difference in vernalised and control samples.

Glutamic acid-Threonine : Except in those grown in White's nutrient solution containing gibberellic acid vernalised fragments have higher contents than the controls.

Alanine : In all fragments from control seedlings grown in the different media except White's nutrient solution, the contents are higher than in vernalised fragments.

Proline : Except in White's nutrient solution containing gibberellic acid, the contents are higher in vernalised fragments.

Tyrosine : The contents in the control fragments grown in glass distilled water and White's nutrient solution are higher than in the vernalised fragments.

Methionine-Valine-Tryptophane : The vernalised fragments grown in all the solutions have higher contents than controls except in White's nutrient solution containing gibberellic acid.

Isoleucine-Leucine : There is a marked increase in the vernalised fragments grown in White's nutrient solution containing gibberellic acid.

Further work is in progress.

These investigations have been carried out in connection with the Scheme of Plant Physiology and Cytology, being financed by the Indian Council of Agricultural Research, New Delhi.

185. Studies in pollen of crop plants : Maize IV : Effect of different sugars on growth elongation of Pollen tubes.

B. SEN and GYANENDRA VERMA, Almora.

Effects of 10 different sugars viz., Sucrose, Galactose, Glucose, Rhamnose, Lactose, Maltose, Mannose, Levulose, Sorbose, and Arabinose on growth elongation of pollen tubes of a South American maize ANT. 350 have been observed. Best sucrose-agar medium for growth of maize ANT. 350 pollen was found to be 15% sucrose solution containing 0.5% agar. Combinations of 5 to 15% of other sugars with 0.5% agar, were tried to determine their optimum concentrations in agar media, which would induce maximum elongation of pollen tubes. For the different sugars they were : Galactose 7.2%, Glucose 9.6%, Rhamnose 6%, Lactose 15%, Maltose 15%, and Mannose 6%. Pollen germination was very poor in Maltose and Mannose. In media containing 5-15% Levulose, Sorbose or Arabinose, pollen grains of Maize ANT 350 did not germinate at all. The comparative growth elongations of pollen tubes in media containing the optimum concentrations of different sugars were : sucrose 302 microns, galactose 260 microns, glucose 322 microns, rhamnose 122 microns, lactose 410 microns, maltose 126 microns and mannose 90 microns.

These experiments have been undertaken in connection with the scheme of Plant Physiology and Cytology, financed by the Indian Council of Agricultural Research, New Delhi.

186. Effect of Anaesthetics-Ether and Chloroform and of Amino-acids, dl-Beta-Phenylalanine, Glycine, Threonine, dl-Aspartic acid and Beta-alanine on growth elongation of Pollen tubes.

B. SEN and GYANENDRA VERMA, Almora.

Ether and Chloroform : Effects of incorporating different concentrations of ether and chloroform in the germinating medium (12.5% sucrose solution) on growth elongation of pollen tubes of Madonna lily (*Lilium candidum*) and Sweet Pea (*Lathyrus odoratus*) have been observed. It was found that 5% ether and 1% chloroform in 12.5% sucrose were toxic to pollen tube growth. Maximum growth elongation of pollen tubes of Madonna lily was observed in media containing 0.1% ether and 0.01% chloroform and of Sweet Pea, in 0.25% ether and 0.1% chloroform. Compared to the lengths of Madonna Lily and Sweet Pea pollen tubes of 568 and 216 microns obtained in 12.5% sucrose in 5 hours, their growth elongation in media containing ether were 1634 and 416 microns respectively and in media containing chloroform 1272 and 352 microns respectively. Compared to the protoplasm of pollen tubes grown in control medium, protoplasm in pollen tubes grown in media containing ether showed slower cyclosis while those growing in chloroform showed better cyclosis and larger protoplasmic particles.

Amino-acids : Effects of 5 new amino-acids on growth elongation of pollen tubes of Madonna lily have been studied. Their optimum stimulating concentrations, which induced maximum growth of pollen tubes were first determined. Compared to the length of 696 microns observed in control medium (12.5% sucrose) in 5 hours, the corresponding growth elongation of Madonna lily pollen tubes in 12.5% sucrose solution containing 0.25 p.p.m. dl-beta-phenylalanine was 900 microns; in 0.75 p.p.m. glycine, 1152 microns; in 0.1 p.p.m. threonine, 950 microns; in 0.5 p.p.m. dl-aspartic acid, 914 microns and in 0.75 p.p.m. beta-alanine, 1248 microns.

These studies have been undertaken in connection with the Scheme of Plant Physiology and Cytology financed by the I.C.A.R.

187. Chromatogram studies in *Coccinia indica* W. & A. with special reference to the differentiation of sex.

K. RANGASWAMI AYYANGAR, Annamalainagar.

The possibility of explaining specific differences between plants from a chemical stand-point is coming to be increasingly recognised. As chemical substances like proteins, aminoacids, alkaloids, phenols etc. generally happen to be present in infinitesimal quantities, for purposes of their detection and description, paper chromatography affords at once a highly delicate and precise method. In the course of investigations in this laboratory on the cytological differentiation of sex in the dioecious climber, *Coccinia indica* W. & A., it was felt that the sexual difference between the male and female individuals of this species may be explained on a chemical basis also. In order to verify this fact, paper chromatogram studies were undertaken using the male and female plants which were growing wild in this locality.

The following salient points could be made out in the chromatogram in respect of aminoacids.

1. Cystine was nearly absent in both the male and female plants.
2. Arginine was present in the female, but was nearly absent in the male.
3. The line of demarcation between histidine and asparagine was clearer in the female than in the male.
4. Hydroxyproline was much denser in the male than in the female.
5. Glutamic acid was denser in the female than in the male.
6. The spread of alanine was crisp and well-defined in the male whereas it was diffuse in the female.

Thus it would appear that the two sexually different plants of *Coccinia indica* exhibit chromatographic distinctiveness with reference to their aminoacid contents.

187A. The relation of iron porphyrin enzymes to induced iron deficiency. I. The effect of excess cobalt supply on the catalase and peroxidase activity of plants.

S. C. AGARWALA and ASHOK KUMAR, Lucknow.

The present investigation was undertaken to find out the effect on an excess supply of cobalt on the activity of two iron-porphyrin enzymes namely catalase and peroxidase in *Cucumis melo* at (i) the seedling stage, experiment I and in (ii) the adult plants, experiment II.

The results of the two experiments are described in the paper and the following conclusions have been drawn :

- (i) The excess supply of cobalt did not appreciably affect the growth of plants at the seedling stage but in the adult plants, 34 and 54 days growth, a marked and highly significant depression in the growth was brought about by the excess cobalt supply.
- (ii) The chlorophyll content of the plants was appreciably depressed, both in the seedlings (168 hours), and in mature plants (34 and 54 days growth), by the excess supply of cobalt.
- (iii) The stage of growth determined the effect of the heavy metals on the iron porphyrin enzymes catalase and peroxidase.

It has been shown that in spite of a very high rate of synthesis of the two iron porphyrin enzymes, catalase and peroxidase, at the early stage of growth, their activity is not appreciably depressed by the excess cobalt concentration. In

the adult stage, on the other hand, the excess cobalt supply has been shown to cause a marked decrease in the catalase activity and generally a marked increase in the peroxidase activity.

187B. The relation of iron supply to the Chlorophyll content and the catalase activity of barley plants grown in sand culture.

S. C. AGARWALA and C. P. SHARMA, Lucknow.

The relation of iron supply to the Chlorophyll concentration and the catalase activity has been investigated in barley plants raised at ten levels of iron supply ranging from 0.056 to 11.2 ppm. It has been shown that chlorophyll concentration and the catalase activity were depressed below 0.70 ppm. iron supply which concentration was found to be critical with respect to both, chlorophyll concentration and the catalase activity in barley plants. That there is a positive correlation between the chlorophyll concentration and the catalase activity in relation to iron supply to barley plants has been further shown.

The results with respect to the iron supply, the iron concentration in the tissue, the chlorophyll content and the catalase activity have been discussed in the light of the results obtained by other workers. The positive correlation between iron supply and chlorophyll content and the catalase activity have been shown to indicate that the fundamental role of iron is very probably in the formation of an organic compound a chelating agent, which is either a stage in the synthesis of protoporphyrin 9, or regulates its synthesis. That protoporphyrin 9 may be a common precursor of both iron and magnesium porphyrins i.e., catalase and chlorophyll respectively, is strongly suggested by Graink (1951).

187C. Studies on the mineral nutrition of *Psidium guajava*.

S. C. AGARWALA and B. K. SINHA, Lucknow.

The paper describes the mineral nutritional disorders found in guava plants (*Psidium guajava*) grown in orchards near Lucknow and Unnao.

A large number of plants of guava growing in orchards near Lucknow and Unnao showed one of the following types of visual effects :—

- (i) death of the growing points of the terminal shoots,
- (ii) severe leaf scorch,
- (iii) dull lustreless foliage with purplish or bronze tints.

In other fruit trees, the above mentioned symptoms are usually associated with the deficiency of one of the macro nutrient elements. Guava plants were raised in controlled sand culture. The deficiency of calcium, potassium or phosphorus was created by lowering the concentration of each treatment separately in the complete nutrient solution and the symptoms of each deficiency were recorded. The concentration of the element in the leaves of guava plants showing the deficiency effects of a particular element was also determined.

From a comparison of the visual symptoms and foliar concentration of the elements in guava plants growing in orchards and those grown in controlled sand culture it has been established that the more common nutritional disorders in guava plants in orchards near Lucknow and Unnao are due to the deficiency of calcium, potassium and phosphorus.

187D. A note on the occurrence of induced iron deficiency, in some ornamental plants growing in Lucknow, with particular reference to the activity of iron-porphyrin enzymes, catalase and peroxidase.

S. C. AGARWALA and N. K. MEHROTRA, Lucknow.

In Lucknow and its neighbourhood a wide variety of plants belonging to several families of angiosperms exhibited symptoms, usually associated with true or induced iron deficiency. The studies reported in this paper were undertaken to investigate how far these symptoms could be ascribed to the physiological unavailability of iron.

Two widely grown ornamentals, showing a high incidence of the chlorosis of the tops, *Murraya exotica*, and *Lagerstroemia indica* were selected for these studies. The chlorotic foliage of each of these plant species was estimated for the iron content, chlorophyll concentration, and catalase and peroxidase activity, before and after the spray of ferric versenate (Fe-EDTA) to the chlorotic leaves.

The results presented in the paper show that:—

In each of the two different species activity of catalase and peroxidase was depressed in the chlorotic tissue, although the concentration of iron in the chlorotic tissue was higher than in the comparable normal green foliage. On the versenate treatment the chlorotic foliage became green and the activity of both catalase and peroxidase became normal.

The low activity of the catalase and peroxidase in the chlorotic tissue, in spite of the presence of appreciably high concentration of iron, and the recovery from chlorosis accompanied with the restoration of the catalase and peroxidase activity to normal on the application of ferric versenate, have shown that the widely spread induced iron deficiency is a result of the physiological unavailability of iron in plants rather than a deficiency in the rooting medium.

ECOLOGY & DISTRIBUTION

188. A species of *Argemone* hitherto unreported from India.

C. S. VENKATESH, Delhi.

The only species of *Argemone* so far reported from India is *A. mexicana* L. It is an exotic from America which has become naturalized and occurs as a common weed throughout the plains of this country. Recently, the author has collected an *Argemone* which is specifically distinct from *A. mexicana*. It has been tentatively identified as *Argemone ochroleuca* Sweep subsp. *ochroleuca*. The main differences between this species and *A. mexicana* are given in the paper. Chromosome numbers of the two species are *A. mexicana*, $2n=28$ and *A. ochroleuca* subsp. *ochroleuca*, $2n=56$.

189. Some Plant Records—II.

M. A. RAU and T. A. RAO, Dehra Dun.

This paper records new localities for the occurrence of the following species of Angiosperms: *Allmania nodiflora* Br. var *angustifolia* (Uttar Pradesh), *Senecio levingii* Cl., *Jaeschkea gentianoides* Kurz., and *Fritillaria cirrhosa* Don (Kumaon). The paper also gives a brief account of some very rare plants of W. Himalayas,

viz., *Falconeria himalaica* Hook. f. (*Wulfenia himalaica* (Hook. f.) Pennell), *Balanophora involucrata* Ilk. f. & T., *Triplostegia grandiflora* Wall., *Streptopus simplex* Don and *Mazus dentatus* Wall.

190. Distribution of lac bearing trees in Manbazar, Purulia District. •

B. B. DAS and T. M. DAS, Calcutta.

The paper describes the distribution of lac bearing trees (*Butea monosperma*) in Manbazar P.S. of the Purulia District. It occupies an area of 257 sq. miles. The altitude of the area is approximately 700 feet above the sea level. The soil is poor and the soil texture varies considerably from clay to clay-loam. The soil pH varies from 4.1 to 5.9. The percentage of soluble salt varies from 0.02% to 0.07%. The quantity of available nitrogen, phosphorus and potassium is also determined. The nitrogen content of the soil is low. The phosphorus content varies greatly from place to place. The potassium content is medium. The annual rain fall is nearly 128 cm. and the temperature varies between 13°C to 42°C.

The total number of Palas trees counted was 3150. This number includes only those trees which fall within the demarcated areas of the forest. The total number of fruits and seeds per plant varies greatly, which is directly related to the height and number of branches of the tree. The minimum number of fruits and seeds (1000-1020) is found in trees that attain a height of 15-18 feet and the maximum number of fruits and seeds (6000-6050) is found in trees of 30-32 feet high.

191. A further contribution to the flora of Jammu & Kashmir State.

T. ANANDA RAO, Dehra Dun.

Plants were collected from the Siwalik range, the Chenab valley, the high uplands of Batote, Kistawar, Bhadrawah of Jammu province, the Pir Panjal range, Lolab valley and the mountain spurs of north-eastern portion of Kashmir province. The present paper describes the general aspects of vegetation in the places visited and a systematic census of the species collected during the exploration.

The vegetation in and around Jammu province resembles the flora of adjacent sub-montane districts of the Punjab State. The province consists of a fringe of flat arid and semi-arid land bordering the Punjab districts, influenced by south-west monsoon supporting scrub-forests, gradually rising by a succession of ranges of broken ground and low hills which form continuation of the Siwalik range with scrub-forests at low levels and mixed vegetation at higher elevations. These lead to the higher uplands with predominant temperate flora bounded by the Pir Panjal of the Himalayan range of mountains.

The Pir Panjal flora is chiefly influenced by altitude and climatic conditions of the adjacent regions. Situated as a boundary between the vale of Kashmir and the Jammu province the spurs, margs and ravines exhibit different features in plant distribution.

The Lolab valley, situated in the north west of Kashmir province is 20 miles long and 8 miles wide having number of pretty meadows with gently rising pine and Cedrus covered hills all round. The mountain spurs of north-eastern portion of the vale of Kashmir runs nearly due south with peaks ranging from 4000 to 5000 m. supporting conifers on the slopes and the sunny margs with many temperate herbs.

Among other plants of interest collected were a perennial aquatic herb *Menyanthes trifoliata* near Shopyian at an elevation of 2000 m. and a perennial parasitic plant *Lathraca squamaria* growing on the roots of *Abies* and *Prunus*, at an altitude of 3000 m. on the way to Tulian Lake.

192. A preliminary note on the Orchidaceae of Eastern India.

ROLLA SESHAGIRI RAO and G. PANIGRAHI, Shillong.

The Orchidaceae, is represented in India, according to Hooker by about 1235 species belonging to 113 genera, most of whom find their wild home, largely as epiphytes, in the rain forests of Eastern India. Of the 500 species belonging to nearly 90 genera collected by the writers so far, the paper presents, in a preliminary way, the distribution of about 250 species belonging to 60 genera, in parts of Orissa, Bihar, Assam, N.E.F. Agency and Tripura. It appears that *Dendrobium*, *Eria*, *Bulbophyllum*, *Coelogyne*, *Cymbidium*, and *Habenaria*, are the richest in species throughout the area under study, many of them extending to Malaya in the south. On the other hand, *Sunipia scarosa* Lindl. and *Ceratostylis teres* Reichb f. appear to be restricted to Nongkhlaw and Digboi of Assam, respectively.

Certain species of *Saccolabium* and *Pogonia* as also those of *Cleisostoma* and *Microstylis* enumerated by Hooker, are now referred to *Acampe*, *Gastrochilus*, *Nervilia*, *Ascocentrum*, and *Malaxis*, respectively, by Holttum. The generic identity of *Habenaria*, *Peristylus* and *Platanthera* is much in question. Similarly, the specific delimitation has been found difficult in certain genera and in *Dendrobium*, the groups *chrysanthum*, *crepidatum*, *cretaceum* as also *chrysotoxum*, *farmeri* and *palpebrae* appear to be species complexes, and need careful investigation.

With a view to provide all adequate materials for a complete revision of the family, about 1200 specimens belonging to about 500 species are kept in cultivation in the Departmental Orchidarium in Shillong to enable us to compare the dried herbarium sheets containing field data with the living materials, to keep spirit collections of flowers for dissection and to draw colour diagrams and take kodachrome transparencies.

193. Some New Plant Records for Nagpur—II.

M. V. MIRASIII, Nagpur.

The author reports the occurrence of seventeen species of Angiosperms previously unrecorded in the published literature on the flora of Nagpur. They are spread over thirteen families of Dicotyledons and one monocotyledonous family, viz., Pontederiaceae. Some of these are introduced species of the Indian flora like *Malvastrum tricuspidatum*, *Cichorium intybus*, *Cryptostegia madagascarensis*, *Croton bonplandianum* and *Pilea microphylla*. They also include some rare species of this area which are restricted to a few spots, e.g., *Cadaba fruticosa*, *Emilia sonchifolia*, *Coldenia procumbens*, *Boerhaavia repanda* and *Monochoria vaginalis*. Brief notes indicating the local distribution, abundance and frequency of the species have been added. Variations in the diagnostic floral or other characters of certain species have been discussed.

194. Studies on the Indian Flora (Eastern India): 7—Observations on the Flora of Siang Frontier Division, N.E.F.A.

ROLLA SESHAGIRI RAO and J. JOSEPH, Shillong.

A preliminary account on the vegetation of the area covered during the botanical exploration in November, 1958 in the Siang Frontier Division, lying within 28° 10'—29° 10' N and 94° 35'—94° 55' E together with enumeration of species collected, is presented in the paper. The region under study, though comprising the wide range of the Himalayas starting from outer spurs near Along up to the

India-Tibet border, covers a limited range of altitude from 350 m. to 2200 m. as the track followed is mostly along the bed of the Siang and Syom rivers, occasionally crossing over high ranges in the Bori area.

The soil is mainly rocky with a cover of clayey sand and Mica sediment along the upper slopes and mostly sandy mixed with rocky boulders along the river beds. Climate is more or less uniformly humid along the Siang river valley with a rainfall of about 4000 mm. per annum both from South-West and North-East monsoons.

Vegetation of the region under study can be divided into three distinct types, namely, (1) Humid Evergreen Tropical type covering an altitude of 350-900 m. from Along to Gaseng area, (2) Humid Evergreen Subtropical type along the slopes adjacent to Siang river bed from Minguing to Kapang La (India-Tibet border) with an altitude of 900-1500 m. and in between the two, (3) Humid Sub-temperate type covering a small stretch of isolated upper slopes of Sirang-Take Paking area of the Bori region with an altitude of 1500-2200 m.

Species of *Ficus*, *Terminalia*, *Callicarpa* and others mixed with *Livistona* and *Pandanus* and climbing species of *Pothos*, *Gnetum*, and *Dioscorea* are common in humid evergreen tropical forests whereas species of *Dipterocarpus*, *Eugenia*, *Saurauja*, *Juglans*, *Acacia*, and others mixed with tall species of *Musa* and palms like *Wallichiana*, *Pinanga*, and *Didymosperma* predominate in the humid evergreen subtropical forest. The sub-temperate belt presents *Quercus-Castanopsis-Michelia-Rhododendron* association densely mixed up with large bushes of *Arundinella*.

This exploration tour yielded more than 400 species of Angiosperms which include interesting material of *Balanophora* and about 30 species of orchids and about 80 species of Pteridophytes including *Psilotum triquetrum* and a dozen species of *Selaginella* besides several other species of Cryptogams.

195. Notes on the Flora of Shillong.

ROLLA SESHAGIRI RAO, G. PANIGRAHI, and G. K. DEKA, Shillong.

This paper presents an attempt in this direction and embodies a floristic account of 400 species, in which Compositae (43 spp.), Orchidaceae (36 spp.), Leguminosae (29 spp.), Gramineae (25 spp.), Rosaceae (23 spp.), turn out to be the families richest in species, whereas *Pinus insularis* Rndl., *Quercus* spp., *Schima khasyana* Dyer, *Manglietia insignis* Bl., etc., form the dominant trees. Several exotic species of gymnosperms and angiosperms now naturalised in Shillong area, are also listed. *Senebiera pinnatifida* DC, *Trifolium repens* Linn., and *Ambrosia artemisiaefolia* Linn., are three new records from the Khasi and Jaintia Hills, as noted at present.

The climax subtropical semievergreen forest which now finds its refuge in the Shillong Peak (1950 m.), is replaced by pine forest and grassland, the latter two competing with each other at several stages in the area under study.

196. *Veronica* Linn. of Eastern India.

NARINDRA MOHAN DUTTA, Calcutta.

This work is part of a study of Scrophulariaceae of Eastern India which the author is carrying on at present under Dr. S. K. Mukherjee of Central National Herbarium, B.S.I. The genus *Veronica* has altogether 18 Indian species, out of which 9 are found in our area. In this paper these 9 species—*V. capitata* Royle ex Benth., *V. lanuginosa* Benth. ex Hook., *V. ciliata* Fisch., *V. javanica* Blume., *V. cana* Wall., *V. anagallis* Linn., *V. deltigera* Wall., *V. himalensis* D. Don and *V. hederifolia* Linn. are described, and a specific key is given for their easy

identification. While examining the sheets of Calcutta Herbarium some sheets were found to differ from specimens of all other described species, and the specimens appeared to be a new variety of *V. cana* Wall. This is named and described as *V. cana* Wall. var. *robusta* in this paper.

197. A contribution to the Phytogeography of Thana District.

S. B. CHAPHEKAR and B. S. NAVALKAR, Bombay.

The homes of 82 species of 55 genera studied in details from Ghodbunder hills and mangroves opposite the hill representing the vegetation of Thana District deciduous forests can be summarily stated as follows :

Tropical Africa 34, India 16, Brazil 8, Australia 6, Malaya 4, China 3, Burma 2, Philippines 2, Borneo 1, New Guinea 1, and Caledonia 1. In case of 3 species, it is found difficult to state their origins, but they can be supposed to be Indian on basis of the study of their family dispersal. From this data we can conclude that the flora of the district is composed of mainly African element. Much of the rest, is native and next numbering in the series are Brazil, Australia, Malaya and China. Others include Burma, Philippines etc. which are minor, from the point of view of their migration to India.

The detailed dispersal study of the same 82 species reveals us that only 10 of them are wind dispersed and 21 are water dispersed. All the rest i.e. 57 are animal dispersed. 6 species are found which have got double way of dispersal i.e. (i) Water dispersal; due to rain wash and sea tides and (ii) Animal dispersal, endozoically or ectozoically. The examples of such twofold mode of dispersal are given by *Terminalia tomentosa*, *Sonneratia apetala*, *Mangifera indica* etc. Almost all the mangroves and plants found near sea shores practise water dispersal through sea.

Some of the plants studied in details are quoted below :

(i) *Terminalia tomentosa*; (ii) *Ehretia laevis*; (iii) *Dalbergia latifolia*; (iv) *Cassia tora*; (v) *Celastrus paniculatus*; (vi) *Bridelia retusa*; (vii) *Ficus hispida*; (viii) *Adina cordifolia*; (ix) *Acacia arabica*; (x) *Casuarina tomentosa*; (xi) *Rhizophora mucronata* and (xii) *Acanthus ilicifolius*.

198. Systematics and Ecology of Indian Plants. I—On the Rainy Season Weeds of Gorakhpur.

D. N. SEN, Gorakhpur.

Rainy season weeds of Gorakhpur have been studied in this paper from the ecological point of view. Some advancement has been made in India on floristic and vegetational studies, but a thorough exploration is still needed. Different observations like the phenology of each plant, its short life cycle, relative frequency-abundance etc., emphasized by Santapau (1956) have been included here.

The present paper mainly deals with those weeds which come up soon after the first showers of the season, excluding trees and shrubs which also come into flower at this time. Grasses are not included here. 147 species representing 107 genera from 39 families have been recorded. Plants belonging to family Malvaceae, Tiliaceae, Leguminosae, Rubiaceae, Compositae, Boraginaceae, Convolvulaceae, Scrophulariaceae, Acanthaceae, Labiatae, Amarantaceae, Euphorbiaceae, and Comelinaceae are more common.

Ecologically, the vegetation can be divided into, (1) those plants which are strictly of the rainy season, i.e., they come up with the rains and complete their life-cycle with the departure of the rains, like *Gynandropsis gynandra* and *Ion-*

dium suffruticosum etc., (2) those, which grow with the rains, but complete their life-cycle after the rains are over, like *Physalis minima* and *Urena lobata* etc.; and (3) those, which germinate late in the season and hence flowering is delayed till winter or so, like *Peristrophe bicalyculata* and *Leonotis nepetaefolia* etc. Taking this strictly into account, a few plants can be excluded from this list, but as there is no strict demarcation of changing seasons, so also the plants enter from one flowering season to the other depending mainly on the environmental factors, which definitely affect them.

199. Observations on the Flora of Narasapur, Medak District, Andhra Pradesh.

K. M. SEBASTINE, K. THOTHATHRI and N. P. BALAKRISHNA, Coimbatore.

The Narasapur Forests lie between 77° 55' to 78° 55' E. and 17° 34' to 18° 20' N. Botanical explorations were undertaken in this area during the months of September, 1958 and April, 1959.

The top soil is sandy to clayey loam with rocks consisting of pink and grey granites. The climate is moist and hot, the temperature varying from 14°C to 40°C. The annual rainfall is 91 cm., mainly precipitated by south-west monsoon.

The vegetation of this region presents the scrub jungle at low elevations with dominant species *Gynnosporia spinosa* associated with *Diospyros melanoxylon* and *Lagerstroemia parviflora*. Patches of grasslands in the scrub jungle show herbs like *Boreria hispida* *Phyla nodiflora* and *Striga euphrasioides* and grasses *Chloris virgata* and *Iscilema laxum*. As the altitude rises the scrub jungle gradually changes into mixed deciduous forests. The transitional zone is characterised by large populations of *Cissus adnata*. *Butea monosperma* is the dominant species in these forests associated with *Madhuca indica*, *Tectona grandis* and *Terminalia bellerica*. The undergrowth is mainly formed by *Bridelia montana*, *Cleistanthes collinus*, *Olax scandens*, *Habenaria platyphylla* and *Sclerocarpus africanus*. The lakes and ponds present large populations of *Aponogeton natans*, *Lagarosiphon alternifolius* and *Nymphae stellata*.

Families Leguminosae, Gramineae and Cyperaceae are well represented in the flora of this region.

200. A study on the Aquatic Plant Community at Gorakhpur in relation to the pH of the Medium.

D. N. SIN and U. N. CHATTERJI, Gorakhpur.

Observation have been made as regards the relation of pH value of water to an aquatic plant community consisting of *Hydrilla verticillata*, *Vallisneria spiralis*, *Marsilea quadrifolia*, *Chara sp.*, *Spirogyra sp.*, and *Ceratophyllum demersum*. High pH values were recorded from the pond water at the time when the ponds were more or less dried up and the vegetation flourished well. This has been summarised for four ponds graphically to show the density of population of individual plants forming the aquatic plant community. The pH value was almost always above 7, thereby showing the plant community's preference towards alkalinity. The pH values were determined straight from pond water, and not from the soil samples forming the bed which supports this community. A considerable variation in the pH values has been observed by the authors. It appears that the surrounding water exerts a greater influence on the plant community in comparison to the pond bed, because the water which accumulates in the pond brings with it dissolved substances not found in the area in which the pond is situated,

The high pH values at the time of luxuriant growth of the vegetation has been attributed to carbon dioxide given out by the plants, which reacts with the sodium hydroxide to produce bicarbonates and carbonates of sodium, making the water alkaline and thus raising the pH values. The presence of sodium hydroxide itself would undoubtedly render the water alkaline, and raise the pH value of the medium, but in view of the fact that a ready supply of carbon dioxide becomes available from aquatic life-forms, it is probably doubtful if sodium hydroxide could continue to remain as such.

201. Hydrophytes of Raipur—I. Aquatic Vegetation.

D. K. TIWARI, Raipur.

No work has been done so far on the Hydrophytes of Chhattisgarh. A detail investigation of the ecology of Hydrophytes has therefore been undertaken of the Raipur, Durg and surrounding areas. This paper deals with the aquatic vegetation only.

Situation, physiography, climate and geology of the area have been described. The aquatic vegetation has been classified into the following three groups :—(1) Free-floating forms, (2) Submerged species and (3) Rooted forms with floating leaves.

A list of plants belonging to the above groups has been described in the paper together with the degree of abundance and flowering period. The following species occur :—

(1) *Free-floating forms* :—*Azolla pinnata* R. Br., *Pistia stratiotes* Linn., *Hygrophila aristata* Nees., *Lemna minor* Linn., *Spirodela polyrrhiza* Schleid., *Eichhornia crassipes* Solms.,

(2) *Submerged species* :—*Isoetes* sp., *Ceratophyllum demersum* Linn., *Blyxa griffithii* Planch., *Hydrilla verticillata* Casp., *Lagarosiphon alternifolius* (Roxb.) Druce., *Ottelia alismoides* Pers., *Vallisneria spiralis* Linn., *Najas minor* Allione., *Potamogeton crispus* Linn., *Potamogeton indicus* Roxb.

(3) *Rooted forms with floating leaves* :—*Marsilea quadrifolia* Linn., *Ipomoea aquatica* Forsk., *Limnanthemum cristatum* Griesb., *Limnanthemum indicum* Thw., *Utricularia flexuosa* Vahl., *Utricularia stellaris* L.F., *Neptunia triquetra* Benth., *Nymphaea lotus* Linn., *Nymphaea rubra* Roxb., *Nelumbo nucifera* Gaertn., *Jussiaea repens* Linn., *Trapa bispinosa* Roxb., *Potamogeton natans*.

202. Hydrophytes of Raipur—II. Marshy Vegetation.

D. K. TIWARI, Raipur.

There is no systematic work available on the vegetation of marshy lands in Madhya Pradesh, particularly in Chhattisgarh area.

This paper deals with the study of vegetation growing in marshy lands and rice fields of Raipur, Durg and surrounding areas.

Species have been divided into the following two groups :

(1) Confined to Marshy habitat only.

(2) Occurring in drier situations also (less luxuriantly).

List of plants belonging to the above groups are mentioned here :—

(1) *Confined to Marshy habitat only* :—

Asteracantha longifolia Nees., *Hygrophila angustifolia* R. Br., *Caesulia axillaris* Roxb., *Eclipta prostrata* Linn., *Enhydra fluctuans* Lour., *Utricularia reticulata*

Smith., *Utricularia wallichiana* Wight., *Ammania baccifera* Linn., *Ammania pentandra* Roxb., *Jussiaea suffruticosa* Linn., *Polygonum glabrum* Willd., *Limnophylla heterophylla* Woodr., *Tamarix ericoides* Rottb., *Alisma reniforme* Don., *Limnophyton obtusifolium* Miq., *Crinum defixum* Ker., *Cyperus pilosus* Vahl., *Elecocharis plantaginia* R. Br., *Juncellus alopecuroides* Cl., *Scirpus articulatus* Linn., *Eriocaulon quinquangulare* L., *Coix lachryma-jobi* L., *Oryza sativa* L., *Monochoria vaginalis* Presl., *Monochoria vaginalis* Presl. var. *plantaginia* S. Laub., *Typha angustata* Chaub. & Bory.

(2) Occurring in drier situations also (less luxuriantly) :—

Ophioglossum sp., *Alternanthera sessilis* R. Br., *Drosera burmanni* Vahl., *Drosera indica* L., *Canscora decurrens* Dalz., *Exacum pendiculatum* Linn., *Oxalis corniculata* L., *Polygonum plebejum* Roxb., *Ilysanthes oppositifolia* Urban., *Vandellia crustacea* Benth., *Phylla nodiflora* (Linn.) Greene., *Canna indica* L. var. *orientalis* Rose., *Murdannia nudiflorum* (L.) Brenan., *Commelina benghalensis* Linn., *Cyanotis axillaris* Roem. & Sch., *Cyanotis cristata* Schultes., *Courtoisia cyperoides* Nees., *Cyperus corymbosus* Rottb., *Cyperus defformis* Linn., *Cyperus iria* L., *Cyperus lalespicatus* Boeck., *Cyperus tegetum* Roxb., *Fimbristylis quinquangularis* Kunth., *Fimbristylis schoenoides* Vahl., *Kyllinga brevifolia* Rottb., *Kyllinga squamulata* Vahl., *Kyllinga triceps* Rottb., *Pycnus sanguinolentus* Nees., *Scirpus michelianus* L., *Scirpus supinus* L., *Cynodon dactylon* Pers., *Paspalum flavidum* Retz., *Paspalum scrobiculatum* L., *Geodorum candidum* Wall.

203. Reproductive activity of Herbs in relation to grazing.

II. R. SANT, Varanasi.

Grazing as an ecological factor, influences the spread and growth form of weeds. Four herbs viz. (1) *Evolvulus-alsinoides*, (2) *Evolvulus nummularis*, (3) *Indigofera linifolia*, and (4) *Convolvulus pluricaulis* in the grazed fields of Banaras Hindu University campus have been studied and these show distinctive distribution in protected, medium and over-grazed fields. Both the species of *Evolvulus* show progression in their populations as a result of heavy grazing while *Indigofera linifolia* declines. *Convolvulus pluricaulis* does not respond to grazing. The biological equipment of the herbs versus grazing in terms of seed out put and reproductive capacity has been estimated. These herbs seem to possess compensating adaptation against grazing as shown in their seed weight, seed out put and reproductive capacity in relation to intensity of grazing.

204. Length and Longevity of Seminal Roots.

S. S. RAMAM, Varanasi.

The behaviour of seminal roots of three perennial grasses viz., *Dichanthium annulatum* Staff, *Bothriochloa intermedia* & *Vetiveria zizanioides* is reported in this paper. The study reveals that these grasses develop a single seminal root on germination of seeds. The nodal roots initiate at the 4th leaf stage of the seedling in *Dichanthium* and *Vetiveria* but they develop earlier as the second leaf unfolds in *Bothriochloa*. The maximum linear growth of the seminal root system is 19 cm. in *Bothriochloa intermedia*, 22 cm. in *Vetiveria-zizanioides* and 11 cm. in *Dichanthium annulatum* at the fifth leaf stage of their seedlings while the seminal root longevity is 7 and 10 weeks in the former two and 5 weeks in the latter.

205. Root studies in relation to Erosion.

R. S. AMBASHT, Varanasi.

The root habit of some plants growing on the eroded banks of the Ganga at Varanasi has been studied with a view to determine their soil binding capacity. Experiments have been designed to estimate the value of each species in checking erosion. The quantity of soil washed from different plant cover growing under uniform conditions has been given in comparison with erosion from a control plot left bare. It has been found that *Saccharum* sp. and *Cynodon dactylon* are most effective binders amongst the plants studied. In many plants growing on slopes a tendency for vegetative propagation is noticed which is more effective as seeds get washed away.

206. Ecological studies of some moist deciduous forests of Tripura State.

ROLLA SESHAGIRI RAO and G. G. K. MURTHY, Shillong.

Ecological studies made during the botanical exploration tour undertaken during August, 1957, in the moist deciduous forests in the Cherilam, Radhakishorepur, Garjee, and Chandrapur reserved forest areas of the south-western parts of Tripura state lying between 23° 30'—24° N and 90° 50'—91° E together with the enumeration of species in different communities, are given in the paper.

The soil is mostly sandy, mixed clay but occasionally a few patches of gravel mixed with laterite have been noted. Climate is hot and humid with 31°C. and 31% as the average maximum temperature and relative humidity respectively, with frequent rains during the period of study.

The general pattern of the vegetation in the region under study can be ascribed to two distinct types namely moist deciduous mixed forest and moist deciduous sal forest distributed in four different areas each of which presenting a characteristic community.

Along Cherilam area comprising mixed forest *Elacocarpus-Terminalia-Sapium-Callicarpa* community is developed whereas in Radhakishorepur area with similar type of forest, *Ficus-Albizia-Lagerstroemia-Vitex* community has been observed. In Sal forest zone two distinct communities are recognised :—(1) *Eugenia-Sterculia-Vitex* in Garjee area and (2) *Grewia-Bridelia-Antidesma* in Chandrapur region. Various common associates among shrubs, climbers, and herbs mixed with these communities are discussed in the paper.

Hedyotis coronata Wall., a Burmese-Malayan species and *Pterospermum semigittatum* Ham. so far collected from Chittagang Hill tracts only, which form the new records for India, have been collected during the study.

207. Ecology of *Desmodium Gangeticum* DC.

P. S. RAMAKRISHNAN, Varanasi.

Desmodium gangeticum DC. is a shade-loving species and thrives best in partial shade. The plants grow in alkaline soils with a pH. range of 7.2 to 7.6, and from moderately calcareous to highly calcareous condition. A definite correlation has been obtained between seed output and exchangeable calcium in the soil. The seed output of the plant decreases with an increase in exchangeable calcium in the soil.

Seeds have no dormancy period and germination of 56% is obtained. The plants have an average seed output of 1154 and the reproductive capacity for the species works of 646.

The difference in the stomatal frequency in 'sun' and 'shade' leaves has been attributed to the drier environment in the 'sun' plants.

The osmotic pressure of the plant sap decreases with an increase in moisture content of the soil. The phenology, biotic factors, seedling morphology, dispersal of seeds etc. have been recorded.

208. Ecology of *Setaria Glauca* Beauv.

P. S. RAMAKRISHNAN, Varanasi.

In *Setaria glauca* Beauv. two ecotypes are shown by culture experiments. They are easily recognised in the field by the length of the panicle.

1. The long panicked form—growing in moist to very moist localities as along the margin of ponds, drainage channels and grass lands.

2. The short panicked form—growing on drier well drained soils of mounds and on tops of old walls.

Differences have been noticed in the average weight of the seeds, the reproductive capacity and the extent of root growth. As regards the osmotic pressure of leaf tissue, the short panicked form gives higher values than the long panicked form.

The seeds of *S. glauca* are found to have a dormancy period of about 4 months. However, they are able to germinate during this period on pre-treatment with Conc. Sulphuric acid.

During germination long unicellular whitish hairs arise prior to the protruberance of the radicle from coleorhiza similar to root hairs and they appear to be absorptive in function.

The plants grow in alkaline soils in a range of pH. 7.1 to 7.8. They grow in highly calcareous as well as non-calcareous soils.

209. Hydrophytes of Bharatpur—A preliminary study.

SHANTI SARUP, Bharatpur.

The hydrophytes of Bharatpur are studied from different points of views. Bharatpur is situated in the East of Rajasthan and lies in the latitude 27°—37" and longitude 77°—33". Its mud ramparts with a ditch still stand around the town.

After studying (1957) the hydrophytes of Jodhpur, the writer found Bharatpur as an interesting place for the study of aquatic vegetation, germination of the seeds of water plants, their sprouting, survival and growth forms and the environmental factors (in relation to aquatic plants).

Eichhornia crassipes. Solm, *Hydrilla verticillata* Casp., *Vallisneria spiralis*. Linn and *Marsilea Minuta* and *M. minuta* var.; *minor* form pure associations. *Ipomoea*—*Limnanthemum* association is formed by *Ipomoea aquatica* Linn., *Limnanthemum nymphoides* Linn., *Hydrilla verticillata* Pool. and *Lemna minor*. Linn. and *Ipomoea-Ceratophyllum* association is formed by *Ipomoea aquatica* Forsk., *Ceratophyllum demersum* Linn., *Limnanthemum nymphoides* Linn., *Lemna minor* Linn., and *Sagittaria saggitifolia* Linn. About 60 plants found in Bharatpur are listed.

210. On a collection of Grasses and Sedges from Ravenshaw College Campus.

H. PATTNAIK and P. C. TRIPATHY, Cuttack.

Ravenshaw college campus is situated between 20.48 deg. N. Lat. and 85.5 deg. E. Long. The place is 97' above sea-level and the soil is chiefly sandy loam in the

open fields and at other places alluvial. The climate is tropical with an average rain fall of 43"—45".

The paper describes a flora of 27 species belonging to the families Gramineae and Cyperaceae. A short description of the habit and period of flowering has been given. An attempt has been made on the successional study of the most common and ubiquitous forms like *Cynodon*, *Panicum*, *Kyllinga*, *Andropogon*, & *Fimbristylis* etc.

211. Some Recent Introductions in the Flora of Patna.

R. P. SINHA and V. THAKUR, Patna.

The present paper is the result of the analysis of the flora of Patna and its suburbs since 1954 in various habitats. The flora of the river-bank, gardens and lawns, 'chaurs', stagnant pools and lakes have all been carefully studied. Some as many as thirty-six Angiospermic plants have been recorded which have not been included in the recent accounts of the flora of this place.

It is possible that a few of the plants might have escaped the notice of previous workers but the majority of them appear to be recent introductions. Although the chance of natural hybridisation has not been completely ruled out it has been pointed out that wind, water and man have been the main operating factors in their introductions.

Plants produced by man are either as horticultural varieties like *Gmelina hystrix*, *Zanthoxylum acanthopodium*, DC., *Clausena pentaphylla*, DC., *Atalantia monophylla*, Corren. etc. or as stray grains with imported seeds of crops like *Spergula arvensis*, L., *Euphorbia dracunculoides*, Lamk., *Crotalaria sericea*, Retz., *Zornia diphylla*, Pers., *Anagallis arvensis*, L. etc. Plants like *Coldenia procumbens*, L., *Cleome chelidonii*, L.f., *Ipomoea reniformis*, Chois., *Phaseolus trilobus*, Ait. etc. appear to have been introduced through the agency of water. Plants like *Dregea volubilis*, Benth., *Urochloa helopus*, Stapf, *Brachiaria ramosa*, Comb., *Vicoa vestita*, Benth. etc. appear to have been introduced by wind.

It has been concluded that the incidence of the above factors is very high in changing the flora of Patna. A further careful study for some coming years is likely to throw more light on the composition and stabilisation of flora of this place.

212. Studies on the Angiospermic Flora of Science College Campus.

MAHENDRA THAKUR, Patna.

Science College, Patna, is situated at 25°37' North latitude and 85°10' East longitude. This is about 180 ft. above the sea level and the average annual rainfall is approximately 48". The soil is chiefly sandy loam and the climate is of monsoon type with maximum summer temperature of 115°F in June and minimum winter temperature of 36°F in January. From the study of the flora of this campus following conclusions are made :—

1. The dominant families, according to mere number of species besides Graminae, are Leguminosae, Compositae and Euphorbiaceae.
2. *Polyalthia longifolia* Benth. and Hook. is the most dominant tree.
3. Among the shrubs *Duranta plumieri* Jacq. and *Bougainvillea spectabilis* Willd are the most common.
4. Besides the common grasses *Trilanthema monogyna* L. is the most common herbaceous species.
5. In general Dicots are more common than Monocots.

6. The habit of the plants varies and most of the trees and shrubs are cultivated. The herbaceous plants constitute the major bulk of the flora and these grow as weeds under natural conditions.
7. Species belonging to 67 families are found in this campus.

213. Studies on the Flora of Singampatti Reserve Forest in Tirunelveli District, Madras State.

K. M. SEBASTINE and A. N. HENRY, Coimbatore.

A detailed study of the flora of Singampatti Reserve Forest has not been made so far and four seasonal exploration trips were made for the collection of plants in the year 1957-58.

The vegetation of this region consists of the scrub jungle type which extends to a height of about 300 M, the deciduous and grassland regions lying between 300 M to 1,000 M and the evergreen forests appearing at a height of about 1,000 M. The evergreen forests, however, get changed into the monsoon type about 1,500 M. The Kakachi regions which forms the highest peak in this area is the typical monsoon forest.

Plant collections were made at various places that had distinctly different ecological conditions and in all a total of 93 families represented by 321 genera, 437 species, native to or naturalised in the forest was found. The families with quite a large number of species are : Gramineae, Euphorbiaceae, Leguminosae, Acanthaceae, Cyperaceae, Compositae, Polypodiaceae (*sensu lato*), Rubiaceae, Labiatae and Verbenaceae. These ten families contain 54.6 per cent of the total flora of the forest. The collections include species which are endemic to this area.

214. The Ecology of temporary ponds of Varanasi.

H. P. MEHTA, Varanasi.

The present study aims at the investigation of relation between growth and distribution of aquatic plants and chemical and physical nature of the substratum in some temporary ponds of Varanasi.

The ponds were ecologically surveyed in their dry and wet phases, and the vegetation was noted. The paper deals with the physico-chemical analysis of pond bottom deposits and qualitative chemical analysis of natural water. The pH of the mud samples are noted and are analysed for nitrates organic matter, calcium, potassium and sodium contents. Variation of these have been noted in different seasons and at different depths.

The vegetation is correlated with changes in edaphic characters of the substratum.

215. Ecology in relation to dry zone afforestation.

HARISH P. BHATNAGAR, Dehra Dun.

Ecological knowledge is of great importance in afforestation, soil and water conservation techniques. In dry zone areas erosion is being governed by a complex of variable factors of the environment. Generally vegetation cover reduces erosion and it governs the moisture regime of a locality to a great extent. Climate of dry zone areas are mostly arid being characterised by low rainfall, high temperature and high amount of evaporation. Therefore, it is necessary to protect

young seedlings and young trees from hot and cold desiccating winds by growing hedges, wind breaks and shelter belts.

Judicious selection of species for afforestation is of paramount importance due to varying physiological conditions of growth and also due to biotic factors. Temperature, rainfall, soil moisture and wind are the major factors which determine the distribution of species. As drought condition is frequently encountered care must be taken to choose species which are drought resistant. Grasses should prove beneficial in the beginning due to their greater pioneering association with local and microhabitat conditions. Soil factors exercise great effect on account of the poor conditions of the soil. Therefore cultural practices which improve the aeration, moisture holding and moisture releasing properties of the soil will be of great use. The biotic factors also play an important role, therefore, artificially planted areas require protection from illicit fellings, fires by men and grazing by domestic animals.

216. Ecological studies in some Sal (*Shorea Robusta*) forests of U.P.

HARISH P. BHATNAGAR, Dehra Dun.

Ecological studies were conducted in some A1, A2, B3, and B4 types of *Shorea robusta* forests (Champions 1936) of Uttar Pradesh. The characters noted in the field were "Dominance" and "Sociability", Frequency and Density in different Plant Communities adjudged during the studies to assess the floristic composition. These ecological studies have indicated that *Shorea robusta* is the most dominant species of these forests with high frequency, density and sociability, covering almost $\frac{3}{4}$ of the area of the quadrat. Other tree species which are characteristic of a particular plant community, attains high dominance and sociability only in the communities which they serve to characterise. *Mallotus philippensis* in the lower storey is the most dominant species in all the communities with a dominance and sociability index which attains a maximum value of 5.2 *Clerodendrum infortunatum* is also found to occur with high dominance and sociability in the communities of moist sal types, though it occurs in all the plant communities adjudged. The characteristic species of herb and shrub stratum occur in greater dominance and sociability only in the corresponding communities.

217. Floristic composition of some Sal (*Shorea Robusta*) forests of U.P.

HARISH P. BHATNAGAR, Dehra Dun.

The floristic composition of some sal forests of Uttar Pradesh was studied in Dehra Dun, Saharanpur, Ramnagar, Haldwani, Gorakhpur, Bahraich, North Kheri, South Kheri, Gonda and Pilibhit Forest Divisions, in those areas belonging to A1, A2, B3, and B4 types of sal forests (Champion 1936). The species found in these forests have been collected in different flowering seasons. In all 290 species belonging to 57 families are collected. In addition to this the association of these species with different types of forest of sal (*Shorea robusta*) has also been assessed on the basis of quadrat studies done separately. Their relative occurrence is also noted as "mostly occurs" on the basis if a certain species is very commonly associated with some particular type of sal forest and "also occurs" if a species is present but not very commonly associated with any particular type of sal forest.

218. On some new concepts in Phytosociological studies of Grasslands. II—Community Coefficient (FXC) ICC.

S. C. PANDEYA, Raipur.

For evaluating the differences and similarities between two stands or two communities on statistical basis 'Community coefficient' has been suggested by Gleason (1920). He used 'frequency index' and obtained FICC (Frequency index community coefficient). The figures obtained by him are above 80 if the two stands under comparison are similar to a larger extent. The FICC method is open to criticism (Gates, 1949), since no distinction is made between a species which occurs in small numbers and one which occurs in large numbers. It may be argued that a species may occur with the same number in two stands and yet may have different cover. Therefore the following modification in the FICC method has been suggested :

(FXC) ICC : ((FREQUENCY × COVER) (INDEX COMMUNITY COEFFICIENT)).

In this modification 5 columns have been set. In the first the fraction representing the product of 'FXC' of each species that occurs in the first stand only is put; in the fifth column the fraction of 'FXC' of the species that occur only in the second stand are put; in the 2nd and 3rd are put fractions of 'FXC' of the species common to both stands; while in the 4th are calculated the differences of the fractions of 'FXC' of each species common to both stands. All the columns are added separately. The 2nd and 3rd columns are added together to give the total of the fractions of 'FXC' of common species that occur in both the stands. To obtain the coefficient, the 'total of common' is divided by the 'total of common' + difference of common (set in column IV) + I + V and multiplied by 100. Examples showing the successful modification of 'Community coefficient' method have been given in the text.

219. On some new concepts in Phytosociological studies of Grasslands. I—Dominance Diagrams.

S. C. PANDEYA, Raipur.

The problem of the homogeneity of a plant community, first brought forward by Nordhagen (1922) has received various treatments both from plant ecologists and mathematicians, without being adequately cleared up. Raunkiaer (1918) suggested 'frequency diagrams' as an expression of the floristic uniformity of a stand.

While investigating the ecology of some grasslands of Madhya Pradesh, the author observed that the degree of homogeneity actually present in the grassland associations 'in abstract' could not be expressed by Raunkiaer's 'frequency diagrams'. This is because 'the frequency diagrams' do not account for the cover of a particular species, which in most cases is responsible for the floristic homogeneity of a stand. It is of course accepted that the 'frequency index', which is the proportion of samples in which a given species occurs, is related to 'dispersion of population', but 'frequency' has no relation with the cover of a species, at least in grassland.

A new method of 'DOMINANCE DIAGRAMS' has been suggested in place of 'frequency diagrams' in order to overcome the above stated difficulties. In the new diagrams all the species found by random sampling (by equal area) in a stand are divided into Raunkiaer's frequency classes. Next the percentage of area covered by all the species (expressed in percentage of the total) falling in a particular frequency class is multiplied by percentage number of species present

in that class. Dominance diagrams are then drawn by plotting the fraction represented by the product of %-cover \times %-number of species against each frequency class. Its advantages are as follows :

1. Unlike 'frequency diagrams' the space occupied by the species falling in each frequency class is also expressed.
2. The degree of homogeneity is clearly made out from the value of class I.
3. Class A shows the presence of accidentals only since they occupy very less area and have the lowest frequency not hampering the 'abstract' homogeneity of the stand.
4. The heterogeneity of a stand is probably related to the values for classes B, C, and D.

220. Factors in the Distribution of Sal (*Shorea Robusta*) Forests in India with Special Reference to U.P. and M.P.

HARISH P. BHATNAGAR, Dehra Dun.

Sal (*Shorea robusta*) occurs over extensive areas experiencing a wide range of climatic conditions. The rainfall is by far the most potent factor. The distribution pattern of rainfall is closely related with the distribution of sal forests. Roughly, sal occurs in the zone receiving annual precipitation of 50"—180". At the drier end, e.g. in M.P., Andhra Pradesh and Western U.P. soil moisture during the drought months becomes the limiting factor. At the moisture extremity in Assam, it merges with evergreen formations. Likewise, quality of sal is dependent on soil moisture. In extremely moist parts of Assam and U.P. best quality of sal is found. As regards temperature the whole tract may be considered as sub-tropical with hot summer, a long growing period and mild but definite winter. On the whole the maximum shade temperature varies from 93°F at high elevation to about 117°F in the hottest part in plains in Chota Nagpur, and the absolute minimum varies from under 30°F to about 45°F.

Within the general climatic types distribution of salt is mainly governed by conditions of geology, soil and topography. Geology of the locality affects the process of soil genesis by imparting it a specific chemical aspect and a characteristic texture. Usually, soil with low pH and low organic matter contents are best suited for sal. Topography plays an eminent role in influencing the soil moisture regime. Effects of altitude and aspect have a marked imprint in the local distribution of sal. In drier parts of sal zone, eastern and southern aspects are usually devoid of sal. Excessive desiccation on these aspects is the limiting factor. Biotic influences like excessive fire and grazing cause severity in ecological conditions and very often seral development of vegetation is either unduly arrested or retrogressed. Also the effects of plant communities themselves on soil and general environmental factors precisely determine the distribution of sal forests.

221. A survey of aquatic weeds of Nandanwara Reservoir with suggestions for their control.

R. K. MEHRA, Gwalior.

Luxuriant growth of aquatic plants become a nuisance in fishery waters. Nandanwara reservoir (district Tikamgarh) comprises a water area of 2,000 acres and is heavily infested with aquatic weeds. 25 species of large aquatic plants were collected from the reservoir, out of which 13 from the weeds. A horizontal

and vertical distribution of the aquatic plants have been studied. Aquatic vegetation is found at beds upto 17 ft. deep.

No floating vegetation is found. Emergent vegetation is estimated to cover an area of 500 acres, submerged vegetation 1400 acres and 100 acres area is without weeds. From the emergent vegetation *Cyperus Procerus* is found at beds with depths upto 2 ft., *Scirpus tumidus* 4 ft., *Typha* species two to six ft., *Jussiaea repens* 2 to 4 ft., *Polygonum tomentosum* 4 to 6 ft., *Limnanthemum indicum* 2 to 9 ft., *Ipomoea aquatica* 2 to 4 ft., from the submerged vegetation *Vallisneria spiralis* 6 to 17 ft., *Hydrilla verticillata* 2 to 9 ft., *Najas minor* 2 to 14 ft., *Potamogeton pectinatus* 4 to 6 ft., *P. crispus* 6 to 8 ft., *Ceratophyllum demersum* 2 to 6 ft. A map of the reservoir giving the distribution of different aquatic weeds is prepared.

Weed control measures have been suggested by every year lowering of water level by 8 ft., treatment of emergent plants with 2, 4-D chemicals, submerged weeds by dragging a beam with spikes through a powerful diesel engine beat. These measures are suggested to be continued for at least 5 years. Introduction of exotic fishes like Mirror carp and the Gorani is also recommended for weed control.

222. Effect of Presowing Treatments of Seeds of Tung (*Aleurites Fordii* Hemst).

SALIL KUMAR CHATTERJEE, Darjeeling.

To minimise the period of germination of Tung (*Aleurites fordii*, Hemst.) experienced in the nursery pre-treatments have been applied to the seeds prior to sowing. Eight hormones and related chemicals (Ascorbic acid, Thiamine, Indolyl propionic Acid, Naphthoxyacetic acid, Phenyl Acetic acid, Malice hydrazide, Serdix L15 and Seradix B) were tried in concentrations of 50, 100 and 1000 p.p.m. Results show much hastening in the process of germination of Tung seeds as a result of pretreatments with hormones and related chemicals. When compared with controls, the enhancement of rate of germination and of the total percentage of germination and of established seedlings were much higher with Ascorbic acid, Thiamine and Malice hydrazide. Indolyl propionic acid, Naphthoxyacetic acid and Phenyl acetic acid did not show remarkable improvements over the controls—higher concentrations showed more or less inhibiting effects. Seradix L15 and Seradix B proved to be inhibiting in all the concentrations. In all the concentrations of all the hormones tried a clear acceleration in the early date of germination was prominent.

223. Studies on the Vegetation of Bandipur Forest.

G. S. PURI and B. M. WADHWA, Poona.

These forests are located at a distance of 56 miles from Mysore on Mysore-Ootacamund main highway and form a part of Mysore District. These are situated in Lt. 18° 8'N and Long. 74° 4'E.

These are mature, open, mixed deciduous type of forests in which the cutting of Bamboo and Teak and burning of litter are common feature, but otherwise these are protected forests.

The following species are observed. Among the trees *Terminalia tomentosa*, *Anogeissus latifolia*, *Tectona grandis*, *Phyllanthus emblica*, *Schleichera trifuga*, *Grewia tillaefolia*, *Butea monosperma*, *Cassia fistula*, *Bauhinia racemosa*, *Terminalia paniculata*, *Atlantia racemosa*, *Zizyphus xylopyrus*, and clumps of *Dendrocalamus strictus* are present.

The shrub layer consists of *Flacourtia* sp., *Randia dumctorum*; and *Canthium dicoccum*.

The ground vegetation is represented by *Curculigo orchiloides*, *Cyanotis tuberosa*, *Curcuma* sp., *Leucas nutans*, *Hedyotis auriculata*, *Euphorbia nerifolia*, *Desmodium gangeticum*, *Spermacoce hispida*, *Vernonia cinerea*, *Scutellaria discolor*, *Deucas cristostoma*, *Achyranthes aspera*, *Oxalis corniculata*, *Heliotropium cchiwaldi* and *Pancratium parvum*.

The common climbers are *Argyria cuneata*, *Asparagus asiaticus*, *Asparagus racemosus*, *Cocculus villosus*, *Hemidesmus indicus*, *Ipomaea obscura*, *Vitis tomentosa*, and *Smilax macrophylla*. ...

Viscum angulatum and *Viscum articulatum* are two common parasitic species.

224. Studies of the Vegetation of Laccadives and Amenidives Islands.

B. M. WADHWA, Poona.

The Laccadive and Amenidives islands form a long narrow belt in the Arabian Sea to the west of South Kanara district in Lat. 14°N—9°N. These consist of a series of isolated islands, mostly of small size viz. Kavarathy, Agathi, Androth, Kalpati, Ameni, Kadmat, Chetlat and Kiltan.

The rainfall ranges between 150 cms.—250 cms. and decreases from south to north. The maximum rain falls in the months of June and July. The shade temperature varies from 70°—90°F; Agathi being the hottest of all the inhabited islands.

The islands proper are usually narrow banks of sand piled up by the action of sea and wind. The reef is covered with boulders of coral limestone and usually sub-merged under a few feet water, but well exposed at few islands namely Kadmat, Chetlat and Kiltan, during the tides. In few islands viz. Chetlat, Kiltan, Kavarathy and Agathi, rock can be traced in Lagoon, round both ends of the islands.

The few tree species which are common in all the islands are *Calophyllum inophyllum*, *Hibiscus tiliaceus*, *Thespesia populnea*, *Hernandia peltata*, *Moringa pterygosperma*, *Terminalia catappa*, *Morinda citrifolia* and *Artocarpus incisa*.

The shrub layer is chiefly composed of *Scarvola koenigii*, *Vitex negundo* var. *incisa*, *Dodonaea viscosa*, *Pamphis acidula*, *Calotropis gigantea*, *Indigofera tinctoria*, *Octmum basilicum*, *Zizyphus oenoplia* and *Cassia occidentalis*.

The common climbers are *Piper betle*, *Tylophora asthmatica*, *Ipomaea sepiaria*, *Dioscorea daemona*, *D. oppositifolia* and *Gloriosa superba*.

The ground vegetation is represented by *Boerhaavia diffusa*, *Aerva lanata*, *Rungia parviflora*, *Sida humilis*, *Euphorbia hirta*, *Anisomeless ovata*, *Evolvulus alshnoides*, *Polygala erioptera*, *Abutilon indicum*, *Ruellia pictula*, *Polycarpea spicata*, *Crotalaria medicaginea*, *Leucas aspera*, *Corchorus acutangularis*, *Aeschynomene indica*, *Ammania baccifera*, *Commelina oblique*, *Cyanotis cristata*, *Colocasia antiquorum*, *Crepis acaulis*, *Indigofera cordifolia*, *Tridax procumbens*, *Vernonia cinerea* and *Portulaca oleracea*. *Lippia nodiflora* and *Ipomaea biloba* were very common near Sea shore, Water ditches and wells. Among the sedges and grasses *Spinifex squarrosus* is very common forming a beautiful covering near shore in all the islands, the others being *Dactyloctenium aegyptium*, *Chloris* sp., *Eragrostis* sp., *Dicanthium annulatum*, *Apluda varia*, *Fimbristylis* sp. and *Cyperus iria*. The most of the herbal vegetation is found near the water wells or ditches or on moist sandy soil.

Cocos nucifera is the main cultivated crop.

225. Studies on the Vegetation of Dara—Shahabad in Rajasthan.

S. K. JAIN and NALINI N. KOTWAL, Poona.

Dara Shahabad area is situated in eastern Rajasthan approximately at longitude 76°E. and latitude 25°N.

The area is botanically underexplored. Botanical collections were made, and specimens were identified. The vegetation was studied by means of quadrats and transects.

The vegetation shows fairly distinct zonation in valleys, slopes and hill tops. Several spots around Dara and Shahabad were studied. Their vegetation is described in detail.

In forests around Dara, the hill tops have trees chiefly of *Diospyros melanoxylon*, *Aegle marmelos*, *Anogeissus latifolia* and *Cassia fistula*. *Holarrhena antidysenterica* is abundant as under-growth. The hill slopes are covered with *Anogeissus pendula*, *Wrightia tinctoria*, *Bauhinia racemosa* and *Dichrostachys cinerea*. *Helicteres isora* is common in undergrowth all over.

The vegetation in valleys is dense. Trees of *Butea monosperma* are dominant. Trees of *Terminalia arjuna*, *Phoenix sylvestris*, *Anogeissus pendula*, *Cordia dichotoma* and *Ficus* spp. are common. *Grewia pilosa*, *Acacia leucophloea* and *Annona squamosa* are very abundant as small trees and shrubs. Open patches in the forest are covered by dense grass growth e.g. by *Apluda mutica* var. *aristata*, *Heteropogon contortus* and *Capillipedium* sp. *Colx lachryma-jobi* grows commonly near water currents. *Ottelia* and *Marsilea* grow in stagnant waters in valley.

In forests around Shahabad such as at Pindasar, Girgavan and Santora the hill tops have forests of *Anogeissus latifolia*, *Terminalia bellerica*, *Diospyros melanoxylon*, *Buchanania lanzan*, *Schleichera oleosa*, *Aegle marmelos*, *Dalbergia latifolia* and *Boswellia serrata*. The undergrowth is chiefly composed of *Nyctanthes arbor-tristis* and *Holarrhena antidysenterica*.

The valleys have *Butea monosperma*, *Acacia chundra*, *Dichrostachys cinerea*, *Prosopis spicigera* and occasionally *Bridelia retusa*. Climbers of *Asparagus racemosus* and *Gymnema sylvestre* are common. *Grewia pilosa* is very common as undergrowth. Two trees of teak were found along a nala in Gargavan forest, the only locality noted with teak so far.

The hill slopes here are covered with *Anogeissus pendula*, *Acacia chundra*, *Aegle marmelos*, some *Boswellia serrata*, *Lannea coromandelica*, *Bauhinia racemosa*, *Zizyphus xylopyrus*, *Cassia fistula*, *Schleichera oleosa*, *Sterculia* sp. and *Diospyros*. *Mitragyna parvifolia*, *Wrightia tinctoria* and *Anogeissus latifolia* are seen in upper parts of slopes.

Some moist spots in valley have patches of *Caesulia axillaris*, *Ammannia*, *Sesbania aegyptiaca* and *Aerva* sp. *Xanthium strumarium* and *Cassia tora* densely colonize roadsides and outskirts of forests in vicinity of habitations.

Very steeply cut rocks have dense bunches of *Eriophorum comosum* hanging from rock crevices.

Sitabari area is an interesting spot. Due to religious association the forests are protected from damage. There is perennial water here and rainfall is about 45—50". There are patches of evergreen or mixed vegetation here, consisting of tall trees of *Terminalia arjuna*, *Mangifera indica*, *Salmalia malabarica*, *Ficus lacor*, *Syzygium*, *Manilkara hexandra*, *Madhuca indica*. Robust *Carissa* climber is abundant.

Along a tank near Kelwara village, there is dense patch of *Pandanus tectorius*. *Butea superba* is very common in the mango gardens near the *Pandanus* forest. The grass *Colx* grows very tall along the tank and its channels and is reported to give shelter to tigers in summers.

226. Ecological studies in the grassland reserves (Kurans) of Khandesh.

G. S. PURI, S. K. JAIN and USHA DESPANDE, Poona.

Khandesh is situated in the northern boundry of the Bombay State and the Satpuras run through the District. Due to heavy felling, browsing and grazing there are vast stretches of land particularly on flat hill tops or rocky plains where the natural vegetation to-day is reduced to a poor scrub stage. Due to the fodder famines, the forest department undertook fencing of large areas to promote grass growth. Several such reserves now exist in Khandesh e.g. at Laling, Pedke and Dondaicha etc.

The general appearance of the vegetation in all these areas is of poor grassy scrub-land. There is now abundant growth of grass with sporadic growth of shrubs and few trees. The only trees in these Kurans are of *Boswellia serrata*, *Hardwickia binnata*, *Lannea coromandelica*, *Bauhinia racemosa*, *Dolichandron falcata* and *Zizyphus* and *Acacia* sp. *Boswellia serrata*, *Hardwickia binnata* and *Zizyphus* are more common. The commonest shrubs are *Acacia catechu*, *Mimosa hamata*, *Rhus mysorensis*, *Grewia pilosa*, *Zizyphus jujuba*, *Gymnosporia montana* and *Euphorbia ninulia*. These shrubs protect a number of herbaceous plants in their bushes.

The ground flora consists chiefly of grasses such as *Heteropogon contortus*, *Melanocenchrus jacquemontii*, *Tragus racemosus*, *Eremopogon foveolatus*, *Digitaria adscendens*, *Dactyloctenium aegyptium*, *Michrochloa setacea*, *Dichanthium annulatum*, *Andropogon pumilus*, *Aristida funiculata*, *Aristida setacea*, *Apluda aristata*, *Cynodon dactylon*, *Cymbopogon martinii*, *Eragrostis unioides*, and species of *Pennisetum*, *Conchrus sparobolus*, *Sehima* and *Jesilema*.

The vegetation was studied by means of quadrats and the paper tabulates the frequency of occurrence of various spp. in the Kurans at Laling and Pedke and also describes the vegetation of these spots in detail separately.

227. Studies on the vegetation of Khandesh.

G. S. PURI, S. K. JAIN and U. R. DESHPANDE, Poona.

Botanical and Ecological studies on the flora and vegetation of Khandesh in Bombay State were started by the Western Circle of the Botanical Survey of India in 1956 (Puri and Mahajan 1957, A, B). These studies were further extended to a number of a new spots in the district. Depending chiefly on soil and biotic influence, the vegetation of the district varies practically from barren waste lands through grassy scrub lands and dry deciduous forests to dense moist-deciduous forests.

The waste scrub lands are found on vast areas in the district. They are subject to heavy grazing and soil erosion and support very sporadic vegetation of shrubs like *Cassia auriculata*, *Rhus mysorensis*, *Gymnosporia montana*. The ground is covered by prostrate herbs like *Indigofera cordifolia*, *Euphorbia microphylla*, *Boerhaavia diffusa*, *Tribulus terrestris*, *Evolvulus alsinoides* and grasses., all of which indicate poor and shallow soil.

The grassy scrub lands have been protected by the forest Department at various places such as Laling, Pedke, Dondaicha etc. These scrub lands or 'Kurans' are an excellent example of the influence of biotic interference. These scrublands have few trees of *Hardwickia binnata*, *Boswellia serrata* and shrubs of *Mimosa hamata*, *Rhus mysorensis*, *Zizyphus jujuba*, *Gymnosporia montana*, *Grewia pilosa*, *Securinega virosa*, and *Clerodendron phlomoides*. There are number of climbers like *Asparagus racemosus*, *Rtuea hypocrateriformis*, *Dalechampia indica*, *Rhynchosia minima*, etc. harboured in these bushes. *Asparagus* is very abundant. The ground is covered by few dicotyledonous herbs like *Evolvulus alsinoides*, *Indigofera*

cordifolia, *Boerhaavia diffusa*, *Cleome viscosa*, *Polygala erioptera* and abundant growth of grasses like *Dichanthium annulatum*, *Tripogon roxburghiana*, *Fremopogon foveolatus*, *Digitalia marginata*, *Dactyloctenium indicum*, *Chrysopogon monilana* etc.

The deciduous forest such as at Kondai-bari, Palasner and number of other places have all the deciduous species along with a number of semi-deciduous species such as *Terminalia tomentosa*, *T. bellerica*, *Pongamia glabra*, *Syzygium cumini*, *Erythrina indica*, *Saccopetulum tomentosum*, *Elaeodendron glaucum*. The shrubs of *Leea sambucina*, *Vitis wooddrowi*, *Securinega virosa*, *Helicteris isora* and climbers of *Dioscorea bulbifera*, *Milletia racemosa* and *Combretum extensum* are also frequently met with. *Dendrocalamus strictus* is commonly present in moist deciduous forest.

The paper gives detailed account of vegetation of the various spots studied.

228. Botanical exploration of Shimoga and Chikmagalur in Western Ghat.

B. S. AHUJA, Poona.

The area under investigation includes the districts of Shimoga and Chikmagalur situated approximately between latitude 13.8°N and 14.8°N and Long. 75.0°E and 76.2°E.

Geologically, most of the area has unclassified rocks i.e. Granite, Gneisses and Laterites. Laterites show on the surface at several places due to the leaching of the soil.

The colour of the soil varies from red to dark brown. On the hill tops and the steep slopes, the soil is shallow and therefore incapable of supporting high forests, while on gentle slopes and in valleys the soil is much deeper and capable of maintaining high forests.

The climate is typically monsoonic. The rainfall varies from 40"—350", the maximum being at Agumbe, which is also known as the "Cherrapunji of Mysore".

The forest vegetation can be mainly divided into following 4 types :—

- | | |
|----------------------|----------------------|
| 1. Evergreen forests | 2. Deciduous forests |
| 3. Scrubs and | 4. Grasslands. |

Due to the high rainfall in most of the area, the evergreen and moist deciduous forests are prevalent.

The common trees in the area are : *Actinodaphne hookeri*, *Alstonia scholaris*, *Alseodaphne semecarpinifolia*, *Anogeissus latifolia*, *Aporosa lindleyana*, *Artocarpus hirsuta*, *Artocarpus lakoocha*, *Careya arborea*, *Cassia fistula*, *Cinnamomum zeylanicum*, *Dillenia pentagyna*, *Syzygium* spp., *Flacourtia montana*, *Carcinia morella*, *Holigarna grahami*, *Hopea wightiana*, *Lagerstroemia lanceolata*, *Litsea zeylanica*, *Macuranga pellata*, *Mallotus philippensis*, *Olea dioica*, *Emblia officinalis*, *Psychotria truncata*, *Schleichera trifuga*, *Strychnos nux-vomica*, *Terminalia chebula*, *T. peniculata*, *Terminalia tomentosa*.

The common shrubs and climbers are :

Allophylus serratus, *Asparagus racemosus*, *Calycopteris floribunda*, *Carissa congesta*, *Cryptolepis buechanani*, *Dioscorea oppositifolia*, *Dodonea viscosa*, *Entada phaseoloides*, *Flacourtia ramontchii*, *Gardenia lucida*, *Holarrhena antidysenterica*, *Ixora nigricans*, *Ixora parviflora*, *Lantana camara*, *Mussaenda frondosa*, *Murraya koenigii*, *Naravella zeylanica*, *Pavetta indica*, *Piper nigrum*, *Pothos scandens*, *Randia tetrasperma*, *Rubus moluccanus*, *Smilax zeylanica*, *Vitis* spp., *Vitex negundo*, *Wagathea spicata*, *Wendlandia notoniana*.

The common herbs are :—

Curculago orchioides, *Curcuma* spp., *Desmodium laxiflorum*, *Flemingia strobilifera*, *Hibiscus furcatus*, *Justicia simplex*, *Mimosa pudica*, *Osbeckia* spp., *Pogostemon parviflorus*, *Vernonia cinerea*.

The flora is being further studied botanically and ecologically.

229. Botanical Exploration of Coorg.

R. K. ARORA, Poona.

The district of Coorg is situated along the western ghats between Lat. 11°N and 13°N and Long. 75°E and 76°27'E.

The area is mainly mountainous with hills varying between 2500'—5700' above sea level. Rainfall varies from heavy to moderate, and the climate is in general monsoonic.

Botanical exploration is being carried on in this district since 1957. Collections were chiefly made at Bagamandala, Kerike, Makut, Mercara, Sampajee, Fraserpeth, Kallhalla, Nagarholle, Tittimatti and Hunsur.

The wet evergreen type of vegetation has been studied at Bagamandala, Kerike and Makut. These forests grow on red soils and bear a number of evergreen species like : *Acrocarpus fraxinifolius*, *Knema attenuata*, *Holigarna grahmi*, *Polyalthia*, *Dipterocarpus turbinatus*, *Diospyros* spp., *Cinnamomum Zeylanicum*, *Palaquium ellipticum*, *Donelia roxburghii*, *Hopea parviflora*, *Hopea wightiana*, *Litsea* spp. and other *Lauraceae*, *Nephelium longana*, *Elaeocarpus tuberculatus*, *Elaeocarpus serratus*, *Garcinia* spp., *Pithecolobium bigeminum*, *Artocarpus* spp.

The moist deciduous type was studied mainly at Tittimatti, Kallhalla and Nagarholle. These forests grow on black-type soil. The chief species met with are : *Tectona grandis*, *Lagerstroemia lanceolata*, *Garuga pinnata*, *Albizia* sp., *Pterocarpus marsupium*, *Grewia tiliaefolia*, *Madhuca latifolia*, *Anogeissus latifolia*, *Diospyros melanoxylon*, *Kydia calycina*, *Buchanania lانسan*, *Terminalia tomentosa*, *Bamboes-Dendrocalamus strictus* and *Bambusa bambos*.

The scrub forests mostly have : *Pavetta indica*, *Ixora*, spp., *Lagerstroemia* and others; thorny shrubs of *Zizyphus*, *Carissa*, *Flacourtia* and *Gymnosporia*. *Euphorbia* sp. is a component of some forests near Hunsur.

About 650 species have so far been recorded and described from the area, most of which are trees and shrubs. The dominant families are : *Euphorbiaceae*, *Acanthaceae*, *Leguminosae*, *Urticaceae*, *Orchidaceae*, *Rubiaceae*, *Compositae* and *Cramineae*.

230. Studies on the Vegetation of Trivandrum District.

G. S. PURI and M. Y. ANSARI, Poona.

The district of Trivandrum in the State of Kerala is situated on the Western Coast, between Longitudes 76°30'N—77°15' and Latitudes 8°15'—8°45'E approximately. The topography of the district varies from the plain coastal areas to the hill tracts in the eastern parts.

Geologically, the district is composed, mainly, of older alluvium and unclassified crystalline, Gneiss etc. It has both the south-west and north-east monsoons. The mean annual rain-fall varies from 80"—100" to as high as 200" or so in the mountainous regions. In general, the area has a tropical climate.

A variety of vegetation is met within the district. Along the coastal areas in the plains, coconut, piper, Tapioca and Paddy are largely cultivated. The first two varieties are of commercial and economic importance, whereas the latter two forms one of the substantial foods of the inhabitants. In the interior are found

the forests which are deciduous or evergreen in nature. The present study of vegetation has been restricted to Ponnudi hills and Kallar areas which are situated on the north-eastern portion of the district. About 200 species have so far been listed from this area. Further exploration is in progress.

The moist deciduous forest forms a patch at Kallar in the evergreen belt. The vegetation is characterised by such species as *Terminalia paniculata*, *Careya arborea*, *Dillenia pentagyna*, *Lagerstroemia speciosa*, *Albizia* sp., *Alstonia scholaris*, *Callicarpa lanata*, *Cassia fistula*, etc. The forest patch is rather open with good undergrowth of grasses and other herbs and shrubs.

The evergreen forest is composed chiefly of *Callophyllum tomentosum*, *Cinnamomum zeylanicum*, *Olea dioica*, *Vitex altissima*, *Ficus hispida*, *Sterculia guttata*, *Cryptocarya wightiana*, *Pterospermum acerifolium*, *Myristica malabarica*, *Xanthophyllum flavescens* etc. These forests are quite dense and impenetrable due to huge network of lianas and woody climbers such as *Ventilago bombaiensis*, *Diploclisia glaucescens* etc. and species of *Calamus* and other thorny plants. A number of ferns colonize the moist and shady areas. Besides, varieties of *Epiphytic* ferns such as *Drynaria* sp., *Pleopeltis* sp. are found growing on the tree barks, as also a number of epiphytic orchids, namely, *Dendrobium* sp., *Obeironia* sp., *Aerides* sp., etc. add to the richness of the flora of the forest.

The shrubs and herbs common in these forests are *Clerodendron infortunatum*, *Blumea spectabilis*, *Lobelia nicotiana*, *Spilanthes acmella*, *Urena lobata*, *Elatostema lineolatum*, *Osbeckia truncata*, *Melastoma malabathricum* and various species of *Jasminum*.

The exploration is being further extended to new areas and ecological studies are also being made.

231. Ecological studies of some Deciduous Forests of Belgaum.

B. S. AHUJA, Poona.

Deciduous forests are of common occurrence where conditions like low rainfall, high temperature and low humidity are prevalent. The deciduous forests of Belgaum District were studied at Sutgatti, Ukkad, Khanapur, Londa, Nagargalli and Jamboti.

These deciduous forests can be divided into two main types on the basis of climatic conditions (a) dry deciduous forests and (b) Moist deciduous forests. These forests can broadly be divided into the following four types:—

- | | |
|-------------------------------|-------------------------------|
| (i) Teak forests | (ii) Bamboo forests |
| (iii) Teak-Bamboo forests and | (iv) Non-Teak-Bamboo forests. |

The following fifteen communities were studied in the area:—

(i) Teak forests:—

- | | |
|---|--|
| 1. <i>Chloroxylon</i> -Teak community | 4. <i>Teak-Anogeissus-Grewia-Chloroxylon</i> community |
| 2. <i>Chloroxylon</i> -Teak- <i>Lagerstroemia</i> community | 5. <i>Teak-Terminalia</i> community |
| 3. <i>Teak-Anogeissus-Chloroxylon</i> community | 6. <i>Teak-Terminalia-Phyllanthus</i> community. |
| | 7. <i>Teak-Terminalia-Xylia</i> community. |

(ii) Bamboo forests:—

8. *Terminalia*-Bamboo-*Phyllanthus* community
9. *Terminalia*-Bamboo community
10. *Terminalia*-Bamboo-*Xylia* community

(iii) Teak-Bamboo forests:—

11. *Teak-Terminalia*-Bamboo community

(iv) *Non-Teak-Bamboo forests* :—

12. *Lagerstroemia-Anogeissus-Diospyros* community
13. *Chloroxylon-Terminalia* community
14. *Terminalia-Xylia* community and
15. *Terminalia-Phyllanthus* community.

Successional details of all these are being worked out.

232. The Deciduous Forests of Coorg District.

R. K. ARORA, Poona.

The paper deals with the floristics of the deciduous forests of Coorg, which have been studied particularly near Kallhalla, Nagarhall and Tittimatti.

These forests are mainly distributed in low rainfall areas, and are better developed in the Central and Southwestern parts of Coorg. The soils in these areas is black in colour, mixed with considerable humus and is gravelly. Most of the forests are developed on the alluvia of various streams and rivers which drain the district.

The following communities have been studied from Kallhalla and Nagarholla :

Tectona-Terminalia-Anogeissus,
Tectona-Terminalia-Grewia,
Tectona-Terminalia-Phyllanthus,
Tectona-Terminalia type, and
Bamboo-teak types

in which one or the other species of bamboos i.e. *Dendrocalamus strictus* and *Bambusa bambos* may dominate.

These moist deciduous forests have a mixed composition with species like : *Tectona grandis*, *Lagerstroemia lanceolata*, *Lagerstroemia parviflora*, *Garuga pinnata*, *Albizia* sp., *Dalbergia latifolia*, *Pterocarpus marsupium*, *Anogeissus latifolia*, *Diospyros montana*, *Kydia calycina*, *Terminalia tomentosa*, *Adina cordifolia*, *Grewia tiliifolia*, *Madhuca indica*, *Emblca officinalis*, *Mallotus phillippensis* and others. In progressive stages, they may have species like *Olea dioica*, *Litsea*, *Actinodaphne*, *Cinnamomum* and others with *Psychotria* as a common shrub, the type representing a link between moist deciduous—evergreen series.

The drier bits near Hunsur-Kallhalla and Hunsur-Tittimatti, have forests with more open top canopy. *Anogeissus*, *Lagerstroemia*, *Bassia latifolia*, *Diospyros melanoxydon*, *Garuga*, *Buchanania latifolia* are more common with shrubs like *Carissa congesta*, *Ixora parviflora*, *Lantana*, *Zizyphus* spp., *Pavetta indica*, *Flacourtia indica* and others. This type is biotic/bioedaphic and has an intermediate status between scrubs and moist deciduous types.

233. Soil Studies in the Forests of North Kanara.

R. K. ARORA, Poona.

Soil studies on profile basis have been carried on in the forests of North Kanara, a high rainfall area situated along the Western Ghats between Lat. 13° 55' and 15° 31'N and Long. 74° 9'E and 75° 10'E.

The soil profiles have been studied under different forest types and their chemical analysis is being done. Black and Red Soil series have been recognized from the area (Puri, Arora, 1958).

Black soils are mostly alluvial and deep, with the parent rock hidden underneath. Profiles have been studied in this type, in Teak/Bamboo areas where a

moist deciduous vegetation comprising of *Tectona grandis*, *Bambusa bambos*, *Dendrocalamus strictus*, *Dillenia pentagyna*, *Adina cordifolia*, *Embllica officinalis*, *Terminalia tomentosa*, *Grewia tiliaefolia*, *Kydia calycina*, *Lagerstroemia lanceolata* and others, is present.

On red soil, usually derived from granite/gneiss or laterite, the profiles have been studied under the following forest types :—

- (a) Semi-evergreen types, with *Xylia xylocarpa*, *Tabernacmontana heyneana* and other deciduous species with evergreen undergrowth.
- (b) In higher evergreen type with vegetation of *Diospyros microphylla*, *Hopcea wightiana*, *Olea dioica*, *Cinnamomum zeylanicum*, *Polyalthia fragrans*, *Knema attenuata* etc. Few profiles have also been studied in lateritic scrub of Siddapur under *Gardenia-Eugenia-Glochidion* type.

Chemical composition of twenty soil profiles representing soil types from different vegetation types have been studied.

The data so far studied shows that :—

(a) The soils in general are all acidic, though soils under Teak Bamboo types appear to be less acidic than the red soils bearing evergreen vegetation. pH varies between 5.2—6.6.

(b) The soils under moist deciduous types seem to be comparatively poor in Nitrogen, but rich in Phosphorus and replaceable Calcium.

(c) Those of semi-evergreen type are rich in Nitrogen and Phosphorus but poor in Calcium.

(d) Those of evergreen types are rich in Nitrogen, but poor in Calcium and Phosphorus.

The studies are being further extended to more localities and soil types.

234. Studies on the Flora of Drier Parts of Mysore State.

G. S. PURI and B. S. PARISHWAD, Poona.

The studies on the vegetation of drier parts of Mysore include our observation on the districts of Bijapur, Raichur, Bellary, Bangalore and Mysore. The area is situated between latitude 12.2°N—17.2°N and longitude 75.8°E—77.6°E. The temperature varies from 60°F to 108°F. The annual rainfall varies from 37.5 cms. to 57.85 cms.

The area is a table land and the average height is about 2000 ft. above the mean sea level. Most of the area is rocky. The common rocks are sandstone, gneissus granite, Deccan trap and at places amygdaloidal rocks are also seen.

The soil is shallow varying from sandy loam to pure sand in texture. There is little alluvial soil met with, only along nalas and the banks of the rivers. The color of the soil varies from red, chocolate brown to black.

The drier parts of Mysore exhibit a degraded stage of vegetation which has been subjected to severe biotic interference. The barren poorly covered slopes all over the area under study clearly indicate this. In these areas very little natural vegetation is left at the present day. The vegetation that does occur is confined to hillocks. There are dry deciduous forests which sometime degenerate into scrub jungle. Owing to the climatic conditions a number of drought resisting, prickly and spiny species are seen.

The forest types studied in the districts of Bijapur, Raichur and Mysore are mostly scrub type. The common plants of the area are as follows :—

Trees :—*Acacia arabica*, *Acacia catechu*, *Anogeissus latifolia*, *Bauhinia racemosa*, *Dalbergia paniculata*, *Mitragyna parviflora*, *Ficus glomerata*, *Hardwickia binata*, *Tectona grandis* (mostly planted), *Pongamia glabra*, *Melia azadirachta* and *Tamarindus indicus*.

The commonest shrubs are *Carissa* sp., *Rhus mysorensis*, *Dodonaea viscosa*, *Zizyphus oenoplia*, *Euphorbia tirucalli*, *Opuntia* sp., *Balanites roxburghii*, *Gymnosporia montana*, *Grewia* sp., *Meyna laxiflora* and species of *Lantana*.

Among the climbers *Asparagus* sp., *Capparis* sp., *Cryptolepis* sp., and species of *Cocculus* are common.

Among the ground flora *Tephrosia purpurea*, *Achyranthes aspera*, *Heliotropium* sp., *Alternanthera sessilis*, *Anisomeles* sp., *Polygala chinensis*, *Tribulus terrestris*, *Aerva javanica*, *Andrographis serpyllifolia*, *Echinops echinatus* and *Lepidagathis cristata* are more common, chiefly as post monsoon plants.

235. Successional Trends in the Vegetation of Various Habitats of Western Rajasthan.

G. S. PURI, S. K. JAIN and N. N. KOTWAL, Poona.

The vegetation in different habitats in Western Rajasthan has been studied through quadrats in transects, in different seasons for about 3 years. The vegetation is subject to heavy biotic interference and is frequently reduced to a low scrub stage.

In sandstone rocky areas large bushes of *Euphorbia nerifolia* harbour a number of tree seedlings. There is abundant tree growth of *Anogeissus* species which successfully regenerates.

Shallow depressions in limestone rocks growth of grasses, with a number of dicotyledonous tree seedlings, in valleys the vegetation tends to be rich and dense and a number of evergreen species such as *Mangifera indica*, *Ficus* spp., *Syzygium cumini*, *Pongamia pinnata*, *Terminalia* etc. grow healthy and regenerate. The successional trend in such protected habitats is towards an evergreen type of vegetation.

In sandy plains low shrubs of species of *Capparis*, *Crotalaria* and *Aerva* etc. predominate, but under protection they develop into tall shrubs and a number of trees such as *Tecomella undulata*, *Prosopis spicigera* and *Acacia jacquemontii* etc.

On gravelly and saline soils the vegetation tends towards tree growth of species like *Salvadora oleoides*, *Tamarix ericoides*, etc.

The vegetation on stabilized sand-dunes comprises of grasses like *Panicum turgidum* and *Cenchrus* spp., and bushes like *Calligonum polygonoides*, *Crotalaria burhia* and *Leptadenia pyrotechnica*. Seedlings of *Prosopis spicigera* are sometimes seen. The trend of succession of vegetation on sand-dunes under closed conditions is an interesting subject for further study.

236. Further Studies on the Vegetation of Dangs District in Bombay State.

S. K. JAIN, Poona.

Studies were made on the flora and vegetation of the Dangs District in Bombay State. The vegetation was studied by the method of quadrats in transects at various localities.

Teak is the dominant species in the protected forests at Mulchund, it is present in 70% of the quadrats studied. The forests at Pimpri have Teak-*Terminalia* community. Clumps of *Dendrocalamus strictus* are frequently seen being present in 50% quadrats. At Ghadvi forests *Wrightia tinctoria* is a very common plant and forms a conspicuous presence in the Teak-*Terminalia* community here. *Wrightia tinctoria* is still more common at some spots such as Piplimal and Chankhel where it is present in 80—90% quadrats. The riverain forests at Piplemar have trees of *Pongamia pinnata*. Its frequency of occurrence here is 60%. *Lagerstroemia*

parviflora is a common plant in several situations, e.g. it is common at Kotbha forests. *Anogeissus latifolia* also is frequently met, and is sometimes the dominant species in a forest e.g. at Kotbha. The forests at Shivbara and Dholeambhar are very dense and Teak, *Terminalia* and *Wrightia* are recorded in 70-80% quadrats. A number of other tree species such as *Careya arborea*, *Gmelina arborea*, *Kydia calycina*, *Garuga pinnata*, *Nitrargyria parviflora*, *Erythrina variegata*, *Meyna laxiflora*, *Adina cordifolia*, *Dalbergia latifolia*, *Ougeinia oiginensis* and *Schleichera* etc. occur mixed in Teak-*Terminalia* forests.

Milletia ovalifolia is a common robust climber, its frequency is up to 90% in some places such as at Lavchuli. *Helicteres isora*, *Leca aspera*, *Carvia callosa*, *Sorghum halepense*, *Holarrhena antidysenterica* are commonest shrubs at all places studied.

Bambusa bambos is abundant near the nala banks, at lower hillslopes, e.g. at Raiwad at Waghahi.

237. Patterning of Forest Vegetation of Red Sandstone Soil.

G. P. MISHRA, Saugar.

Reserve forest at Khanpur has been selected for the present study. Essentially the forest vegetation here is of the Tropical Dry Deciduous type, chiefly governed by the dry climatic condition prevailing for nearly nine months in a year. The vegetation is very rich in species. The rocky substratum displays a great variety of slopes with different gradients and also marked dip. The vegetation in this forest has been divided into a number of stands having distinct physiognomy on account of dissimilar topography and aspect of slope.

1. *Terminalia*-*Diospyros* type of stand is located in a basin between hills where the colluvial soil is deposited to varying depths. Common tree species are *Terminalia tomentosa* W. & A., *Diospyros melanoxylon* Roxb., *Buchnanian Lanza* Spreng., *Anogeissus Latifolia* Wall, etc.

2. On a very gentle slope facing south, with red sandy soil, hardly a few inches deep in between the boulders, *Aegle-Lagerstromia* community occurs. The common tree species are *Aegle marmelos* Corr., *Lagerstroemia parviflora* Roxb., *Lannea coromandelica* Merr., *Diospyros melanoxylon* Roxb., etc.

3. *Lagerstroemia-Diospyros-Terminalia* community occurs on a slope facing north. It is shaded by a high precipitous hill. The common tree species are *Lagerstroemia parviflora* roxb., *Diospyros melanoxylon* Roxb., *Terminalia tomentosa* W. & A., *Aegle marmelos* Corr., *Bauhinia racemosa* Linn., *Lannea coromandelica* Merr., etc.

4. *Gardenia latifolia*-*Odina woider* type of community has occupied a small area on two precipitous slope (one facing east the other facing north) where the river cleaves a mountain ridge. The slopes are rocky with absolutely no soil at places. The common tree species are *Gardenia latifolia* Ait., *Lannea coromandelica* Merr., *Aegle marmelos* Corr., *Diospyros melanoxylon* Roxb., etc.

5. Bare rocky hill tops are occupied by *Sterculia-Ficus-Euphorbia* type of community. The characteristic species are *Sterculia urens* Roxb., several species of *Ficus* on rock fissures, *Euphorbia neriifolia* L. etc.

6. A vast area in the forest, around the villages or river, in the basin region of the valleys is occupied by *Butea-Zizyphus-Acacia* community. The common species which are associated with *Butea monosperma* Taub., are *Zizyphus jujuba* Lamk., *Acacia leucophloea* Willd., *Acacia catechu* Willd. etc.

7. On the banks of the river *Terminalia arjuna-Eugenia-Ficus* type of community forms two narrow belts. The common species of this riverian type of stand are *Terminalia arjuna* Bedd., *Eugenia heyneana* Wall., *Ficus racemosa* Linn., *Gardenia latifolia* Ait., etc.

PALAEOBOTANY

238. Microspores discovered from the coal sample No. 1 from Rungta Coal-mines, in the South Rewa Gondwana basin.

SHIVDAYAL SAKSENA and K. MURALI KRISHNA, Bhopal.

On mass maceration of the coal sample No. 1, from Rungta Coal-mines large number of spores have been found, which fall under categories Sporites (one genus) and Pollenites (nine genera), thus ten genera in all.

239. A Fossil Dicotyledonous Wood with Tile Cells -from the Deccan Intertrappean Beds of Mahurzari.

L. J. SHALLOM, Nagpur.

A fossil dicotyledonous wood with tile cells in the medullary rays, is being described for the first time from the Deccan Intertrappean beds of Mahurzari in Nagpur District.

Besides the presence of tile cells of *Pterospermum* type the other characters of the fossil wood used for its identification are as follows:—1. Wood diffuse porous, with vessels solitary or in radial rows of 2's or 6's. 2. Parenchyma paratracheal, with terminal parenchyma present though not very well defined. 3. Medullary rays both uniseriate and multiseriate, multiseriate rays very large. 4. Intervessel pits minute, orifices sometimes fused. 5. Fibres non-septate, storied condition not very clear.

The medullary rays of the Malvales represent a unique condition in the presence of tile cells. Confined to this group are the three families Bombacaceae, Sterculiaceae and Tiliaceae. Some of the genera of these families show the presence of tile cells either of *Pterospermum* type or *Durio* type. Comparisons of the fossil wood are only done with those genera with *Pterospermum* type of tile cells, since the fossil wood show the presence of the same, which is quite distinct from the *Durio* type.

Further, the family Bombacaceae had to be eliminated because of the abundance of parenchyma in its woods, which character is absent in the fossil wood.

The fossil wood shows many characteristics similar to woods of the families Sterculiaceae and Tiliaceae. The storied nature of parenchyma in the fossil wood is still under consideration, the exact nature of which may later decide to which of the two families the present fossil wood would finally belong.

240. A New Specimen of Nipa Fruit from Deccan Intertrappeans of India.

S. D. CHITALEY, Nagpur.

Presence of *Nipa* fruit in the Deccan Intertrappeans of Mohgaon Kalan was reported by Rode in 1933 from a single specimen. One more specimen has been recently collected by the author from the same locality. This discovery of the new specimen of *Nipa* from Mohgaon Kalan cherts is of great significance in reinforcing the view on the age of the Deccan Traps by Sahni.

The fresh specimen is a one-seeded drupe with six longitudinal ridges ending in an apical distinct umbo. It measures 6.5 cm. in length and 5 cm. in width at its broadest distal part. The single seed inside is slightly flattened and has a

prominent sulcus with endocarpic ridge dipping into it and extending from the base to the top of the seed.

Comparisons have been drawn with *Nipa hindi* Rode, *Nipa Sahni* Lakkhanpal and *Nipa Burlini* Brongniart. It is revealed that this new specimen of *Nipa* is smaller than *Nipa Sahni* but bigger than *Nipa hindi* and fitting well with *Nipa Burlini* in size. It differs, however, from the latter two by the presence of endocarp ridge projecting into the sulcus and extending from the base to the top of the seed. Preservation of the material is satisfactory and structural details are under investigation for further specific identification.

240(a). On the Anatomy of a New Cycadean Type of Stem, *Sewardioxylon Sahni* Genet Sp. Nov. Gupta from the Jurassic of Rajmahal Hills, Behar.

K. M. GUPTA, Ajmer.

Among the many stems of the Bennettitalean type collected by the author from a well known locality, Amerjola in the district of Amarapura, a stem showing very prominent cycadean features was discovered. Although its preservation is far from satisfactory, it clearly presented a broad pith, wide medullary rays, medullary vascular bundles, accessory rings of growth and single bundles passing out as leaf traces. As far as the author is aware such a stem structure has not been described in any Bennettitalean stem from India; the structure in both *Bucklandia indica* and *B. Sahni* is very different from what I find in the present specimen. On the other hand there seems to be a close resemblance between this wood and the condition obtained in many living genera of the Cycadaceae like *Gycas*, *Stangeria*, *Encephalartos* etc. Due to the poor preservation, the pitting on the radial walls of the tracheids have not yet been studied; but it is hoped that better material may be available in the collection before the final paper is prepared.

Photographs and drawings will be projected on the screen at the time of the congress.

HISTORY OF BOTANY

241. Ancient Science (Biology).

K. A. PATWARDHAN, Indore.

The Science of Biology, being a younger sciences compared to its sister sciences—Physics and Chemistry remained neglected in India and even in the West till about a few decades of this century. It is only during the past quarter of the century that it has its due place and now with the aid of these three fundamental sciences scholars are trying to solve the riddle of the Universe. In the Cultural History of India one finds that during the past 2500 years the principle of life negation was responsible for the neglect of scientific studies although before that period these three fundamental sciences were studied very widely and we can discern that from a close study of the Vedic Literature. These were then studied as Bhargawi or Adhibhantic Vidya—Chemistry, Panchagni or Adhidaivik Vidya—Physics and Pran Vidya or Adhyatma Vidya—Biology. An attempt has been made in the end to show that the study of the Sciences of Biology of today is the same as the study of Pran Vidya or Adhyatma Shashtra of the Vedic period and the findings of both are practically the same even in details,

242. A Simple Pyronin-methyl Green Technique for Plant Tissues.

A. K. MUKHERJEE and P. N. BHADURI, Calcutta.

Largely as a result of investigations by Brachet (1940, 1953), Kurnick (1949, 1955), Kurnick and Mirsky (1949) and Kurnick and Foster (1950), a number of standing schedules have been developed for the differential and selective staining of DNA. and RNA. of various animal tissues by the basic dyes pyronin and Methyl Green. As satisfactory result are often not obtained when these schedules are followed in case of plant material, a modified schedule for it has been developed which has given satisfactory result in root-tips of *Allium cepa*, pollen mother cells of *Rhoca discolor*, root-nodules of *Lathyrus sativus* and ovules of *Allium cepa* at different stages of development. (Illustrated by coloured photomicrographs). Incidentally, the root-nodule bacteria of *Lathyrus sativus* has been found to be strongly Pyronin-positive.

Schedule. Take serial paraffin sections of materials fixed in Carnoy's fixative (6 alcohol : 3 chloroform : 1 glacial acetic acid) for 10-12 hours down to distilled water. Invert fresh tissues smeared on slide in the same fixative for 2 hours, and take down to distilled water as usual.

1. Stain in Pyronin-Methyl Green mixture for 15 minutes at 20°C. (2% aq. Pyronin—50 cc., 2% aq. Methyl Green—30 cc., distilled water 10 cc., chloroform—10 cc.).

2. Quickly dip in distilled water, blot off superficial liquid between folds of filter paper and proceed as follows :

Normal Butyl alcohol—10 minutes. Pure chloroform—10 minutes. Normal Butyl alcohol—5 minutes. Toluol—1 hour. Mount in neutral balsam and allow to dry at 40°C.

SECTION OF ZOOLOGY AND ENTOMOLOGY

*President :—*DR. H. D. SRIVASTAVA, M.Sc., D.Sc.

Abstracts

PROTOZOOLOGY

1. The Coccidian Oocysts of Indian Cattle.

B. S. GILL, Izatnagar.

A survey of coccidian oocysts occurring in faeces of 250 cattle, under 2½ years of age and belonging to Izatnagar and Karnal dairies is described. A total of 12 species, viz., *Eimeria subspherica*, *E. cylindrica*, *E. zurnii*, *E. bovis*, *E. bukidenonensis*, *E. wyomingensis* (*E. ildefonsoi*), *E. canadensis*, *E. alabamensis*, *E. brazilensis*, *E. thianethi*, *E. ellipsoidalis* and *E. auburnensis* were recognised. A colourless variant of *E. canadensis* was also recognised. The percentage frequency of the occurrence of these coccidia in the 250 samples was : 9.2, 12.8, 40.8, 34, 8.8, 41.2, 27.6, 14, 4.8, 2, 26.8, and 26.8 respectively. The colourless variant of *E. canadensis* occurred in 6% of the samples. Their morphology, biometrical characters and sporulation times have been described.

2. The Coccidian Oocysts of Indian Pigs.

B. S. GILL, Izatnagar.

Faeces of 20 pigs were examined for coccidian oocysts. Though apparently healthy, all of them were seen passing varying numbers of oocysts. A total of six species of coccidia, viz., *Eimeria scabra*, *E. perminuta*, *E. polita*, *E. spinosa*, *E. debliccki* and *Isospora suis*, were recorded. This is the first record of occurrence of these coccidia from India. Their morphology, biometrical observations, and sporulation times have been described. Justification for splitting *E. scabra* into two varieties, viz., *E. scabra* var. *scabra* and *E. scabra* var. *ellipsoidalis*, has been provided.

3. Property of regulation in amoeba after trinitrophenol treatment.

B. HAJRA, Calcutta.

Cytomorphological changes occur in a species of soil amoeba, viz. *Acanthamoeba* sp., when they are exposed to the effects of different concentrations of picric acid. It is noted that amoeba can regulate itself before encystment when it is treated with 0.01% concentration of the acid. The effects of this concentration have been studied to follow the phenomenon of regulation cytochemically.

Alkaline phosphatase and basophilia show a gradual depletion after 10 minutes treatment from cytoplasm towards nucleus. Regulation of alkaline phosphatase starts after 3 hours and that of basophilia after 5 hours. Amoebae appear cytochemically normal before encystment. The weakening of nuclear Feulgen reaction

is accompanied by the appearance of certain Feulgen positive bodies in cytoplasm. The Feulgen reaction of the nucleus becomes normal before encystment.

Substance regulation begins first in nucleus and proceeds towards cytoplasm.

Relation between nucleus and cytoplasm in the regulative mechanism of amoeba has been discussed.

4. On a New Species of *Trichomonas* from *Polyplectron Bicalcaratus* (Bhutan Peacock Pheasant) at Calcutta Zoo.

L. S. HIREGAUDAR and H. N. RAY, Calcutta.

A new species, *Trichomonas longiflagellatum* n. sp., has been described from *Polyplectron bicalcaratus* at Calcutta Zoo. This species differs from *T. hoare* in its bigger size and in having flagellae nearly twice as long as the length of the body. It appears that these flagellates are the normal inhabitants of caeca of birds and under favourable conditions they seem to multiply in enormous numbers and probably aggravate the diarrhoeic condition due to some other parasitic infection.

5. Radiation breaks in a cell body of amoeba.

SIVATOSH MOOKERJEE, M. G. ALAMELU and ANJALI MOOKERJEE, Calcutta.

The X-rays can act like an 'invisible knife' to segregate nucleus from cytoplasm in amoeba. In this investigation effect of X-rays on trophic forms of amoebae has been discussed from the point of view of one phenomenon, namely breakage in individual cell body.

Radiations were carried out at 70 K.V. and 3-4 m.a.

Studies reveal that when a radiation between 600r—1200r is given, a large number of amoebae fragments. The highest incidence of the phenomenon is observed at 1000r—1200r. Amoebae readily break into 6—7 fragments after 24 hours of radiation. Central portion invariably contains nucleus surrounded by a thin case of cytoplasm. Other portions are enucleate and are of variable sizes.

Similar effects of fragmentation can be obtained in amoeba if the total dose of 1000r is divided in fractions and employed successively in the following generations of the organism.

There always existed a relationship between number of vacuoles formed and the number of fragments produced. It seems that contiguity of surface layer is disrupted at the places where vacuoles burst. This is perhaps due to the failure of congealing the surface layer at the places of eruptions. This is a change brought about by radiation on the protoplasm of amoeba.

The fate of nucleated and enucleated portions is being studied.

6. Extension of surface layer in transporting vacuoles from the cell body.

SIVATOSH MOOKERJEE and P. L. D. WAIDYASEKERA, Calcutta.

The nature of surface mobilisation and vacuolar activity in trophic amoebae after treatment with 1.5% Bacto-trypsin have been worked out. The surface activity from the time of treatment to encystment is nearly 60 minutes. After treatment vacuolar activity is increased. Vacuolar activity seems to be related to the removal of the obnoxious substances from cell. The effects of 1.5% Bacto-trypsin on trophic amoeba show that the surface of the organism is stretched out to become instrumental in transporting vacuoles from the site of their origin in protoplasm to out-

side. Such a phenomenon of pseudopodial activity is not usually noticeable in dosages above and below 1.5%.

The results have been discussed in the light of dynamic activity of lipo-protein matrix of cell surface.

7. Temporary cytoplasmic inseparation in amoeba after centrifugation.

SIVATOSH MOOKERJEE and DIPIKA MUKHERJI, Calcutta.

Centrifugation has been used as a tool to usher morphogenic changes in amoeba. Experiments were carried out on a species of soil amoeba, *Acanthamoeba Sp.* and centrifugation force was generated at 3000g for 10 minutes.

This dosage produced an array of peculiarities. Normal process of binary fission in amoeba was disturbed and in the majority of cases a cytoplasmic lag was observed. A large number of amoebae remained connected together by varying lengths of cytoplasmic strands. Cytoplasmic strands might be thick or thin. However, at a later stage, these connected amoebae separated into singles and encysted. The encystment was abnormal with respect to the pattern of cyst wall.

The above results confirm that centrifugation has a definite effect on cytoplasm, while nucleus remains undisturbed. Centrifugation force seems to disrupt the surface organisation of amoeba, and as a result it leads to disharmony between nuclear and cytoplasmic separation. However this cytoplasmic inseparation is made up at a later stage, and this may be due to a subsequent reorganisation of the surface layers to its original form.

8. Pigment characteristics in different races of *Blepharisma undulans*.

A. V. S. PRABHAKARA RAO and B. R. SESHACHARI, Bangalore.

A comparative study of the pink pigment from five different races of *Blepharisma undulans* obtained from different parts of the world has been made. The pigment from all the races was found to be bleached on exposure to sunlight. In the acid range the colour of the pigment was pink. In the alkaline range the colour turned green but the time taken for attaining the green colour was different in the different races. The rate of growth in the different races is also different. Resistance to different wave lengths of light varied in the five races. These resemblances and differences in the pigment properties constitute another tool in the classification of these races of *Blepharisma undulans*.

9. Further Observations on the E. E. Phase of a Malaria Parasite in the Flying Squirrel, *Petaurista Inornatus*.

H. N. RAY. Calcutta.

Ray's report (1949) about the occurrence of group of small cysts showing merozoites in the liver of flying squirrels (*Petaurista inornatus*) seems to have created some confusion in the literature on E. E. Phase of malaria parasites. Garnham (1952) for instance, in some abnormal merocysts in the liver of baboon (*Papio papio*) encountered convolutions and trabaculae dividing the protoplasm into compartments and stressed its morphological similarity with the group of small cysts described by Ray. Again, Edeson (1953) encountered cystic bodies in the liver of Malayan monkey (*Macacus irus*) the finger like processes of which closely resembled Ray's group of small cysts. In this article the author has brought for-

ward evidences to show that each small cyst in a group was a separate entity and their appearance in groups resulted from the infection of a large number of parenchyma cells in a given foci.

While discussing the systematic position the author has indicated its closer relationship to *Nycteria* than *Plasmodium*. It has however been emphasized that until the arthropod cycle of this parasite is known it would be premature to refer it to any one genus, and, therefore it would be better to refer it as *Plasmodium*. sp. for the time being.

10. Some Observations on the Life-history of *Eimeria Labbeana* Pinto, 1928, a Coccidium of Domestic Pigeons at Calcutta.

N. N. RAY and L. S. HIREGAUDAR, Calcutta.

The life-history of *Eimeria labbeana*, has been studied by experimentally infecting coccidia free pigeons with a pure strain of oocysts obtained locally at Calcutta. The whole life-cycle is completed within 72-96 hours and takes place in the terminal portion of the small intestine and the anterior portion of the large intestine. In a pigeon killed at 18 hours, the immature and mature schizonts were found confined to the tips and sides of the villi of the small intestine and there appeared to be only one schizogony cycle in this coccidium, gametogony started immediately after schizogony and occurred further down in the anterior portion of the large intestine. The fertilised oocysts were discharged 72 hours after infection. Under ordinary circumstances, *E. labbeana* is considered as non-pathogenic as it has been found to have only one generation of schizogony cycle and the number of merozoites produced are comparatively few in number.

11. Organizer problem in hydra.

SOMES SANYAL, Calcutta.

In the realm of morphogenesis, organizer problem in hydra is not a well understood phenomenon. Two sets of experiments have been performed to understand the problem. In one set of experiment the nature of induction at different levels of the host has been studied. In the second series of experiment, the different portions of the induced axis are removed after implantation.

There is no qualitative difference in the hydranth induction by hypostome graft at the different levels of the body of hydra. The induced axes are reabsorbed within the host, if the hypostome and tentacles are removed after induction. It is concluded that organizer action in hydra is largely a manifestation of the self-reconstitution of the hypostome, which as a dominant region draws within its own field portions from the host.

12. Regeneration experiments on *Blepharisma* sp.

B. R. SESHACHAR and P. B. PADMAVATHI, Bangalore.

The regeneration of anterior, middle and posterior fragments of *Blepharisma* has been studied with respect to size, macronuclear content, polarity and life-cycle.

The mortality of fragments is greatest in the middle fragments and least in posterior fragments.

Provided fragments measure 200 μ , regeneration occurs within definitive times, irrespective of fragment size.

A minimum of macronuclear material is essential for regeneration. Macronucleus is equipotential at all stages. At any stage, complete regeneration is always contingent upon the presence of a part of the macronucleus.

Presence of the original contractile vacuole accelerates the formation of a new peristome, and presence of the original peristome accelerates the formation of new contractile vacuole.

Fission rate was not affected by cutting showing that there is no critical size for fission in *Blepharisma*.

13. Comparative account of conjugation in races of *Blepharisma undulans*.

B. R. SESHACHAR and Miss A. VASANTHIY BHANDARY, Bangalore.

An account of conjugation in three races of *Blepharisma undulans* is described. Previous work (Padmavathi, 1957; Bhandary, 1959) has shown interesting features in the conjugation phenomena in two races of this ciliate species. The present study shows that in the behaviour of the macronucleus, in the divisions of the synkaryon and its products, formation of the nuclear analgen and in the phenomena of nuclear reorganization, *Blepharisma undulans americanus* is different from the other races studied in this laboratory.

14. Nuclear Apparatus of *Frontonia leucas* (Ehrbg.).

Miss R. VIMALA DEVI and B. R. SESHACHAR, Bangalore.

* The paper deals with a study of the nuclear apparatus of *Frontonia leucas*, in the vegetative condition as well as during binary fission. Micronuclei divide mitotically and show the first visible signs of division. They complete their divisions before the macronucleus completes its division. In some cases the macronucleus exhibits chromatin elimination, the nature of which is not yet clear. Macronucleus completes its division before that of the cell as a whole. The distribution of micronuclei among the daughter cells is often unequal. Micronuclear division is synchronous. The macronucleus regains its oval shape and size before the daughter cells separate and the micronuclei condense into circular bodies arranging themselves around the macronucleus, as in the vegetative cell.

PORIFERA

15. The differentiating capacity of dissociated sponge cells.

B. GANGULY, Calcutta.

The intricacy of regeneration in a fresh water sponge (*Ephydatia* sp.) depends largely on the behaviour of individual cells during early hours of contact. Cellular contact is a necessary prerequisite to bring about the phenomenon of regeneration. The amoeboid cells play the most important role in regeneration. In isolation, cells dedifferentiate and attain a generalised state before regeneration. Excepting amoeboid cells, other cells can only redifferentiate into original fate, e.g. pinacocytes, scleroblasts, choanocytes. Amoeboid cells completely lose their original characteristic and redifferentiate into other cell types. These are pluripotent cells. Within an aggregate, cells undergo some sort of assortment. Archeocytes remain

in the periphery and other cells in the middle of the mass. Such orientation of cells is observed from the beginning of cell aggregation.

16. Vacuole formation in amoeboid cells of a fresh water sponge.

B. GANGULY, Calcutta.

Amoeboid cells of fresh water sponge (*Ephydatia sp.*) show no vacuole immediately after dissociation. Vacuoles appear as small round bodies after 3 hours of suspension in pond water (pH 7.1). These vacuoles do not exhibit any sign of rapid 'diastole' and 'systole', but remain almost stationary. Appearance of vacuole 3 hours after dissociation suggests that they are produced as a means to cope with the altered environmental condition in isolation. It has also been shown that changes to higher pH and to different temperature shocks accelerate vacuole formation in amoebocytes. Amoebocytes with vacuoles are less capable in forming normal aggregates.

Studies are in progress to induce vacuole formation in amoebocytes *in vivo* under different experimental conditions.

COELENTERATA

17. Dual capacity of differentiation of the middle piece in hydra.

SIVATOSH MOOKERJEE, Calcutta.

Two types of determinants, namely, hypostome-wise and basal disc-wise, exist in the organisation pattern of hydra. Topographically, middle piece occupies a position in between the two opposing systems. Experiments were conducted to understand the nature of differentiating capacity of the middle piece by isolation and implantation.

Small fragments are explanted and rendered as grafts in the vicinity of hypostome and basal disc. In isolation, the middle piece isolates differentiate into a small hydra. The middle piece, when grafted in the anterior region of hydra, results in the formation of a basal disc. When grafted near basal disc of the host, hypostome and tentacles are formed.

The mode of differentiation in implants, in comparison to that in isolate, warrants certain host-graft interactions. Experiments clearly indicate that working of the intrinsic factors in implant depends not only on the type of extrinsic property of host tissue interacting but also on its distance from the graft.

The meaning of quality and distance of tissues in interaction has been discussed.

18. Response of interstitial cells of hydra to the action of nucleic acids.

SIVATOSH MOOKERJEE and ANIMA BOSE, Calcutta.

The interstitial cells on the bodywall of hydra remain in a state of totipotency.

Two types of nucleic acids were tested upon the interstitial cells to observe the mode of gonad differentiation.

Nucleic acid from yeast source, which is mostly RNA, is ineffective. The effect of nucleic acid from thymus, which is largely DNA, is positive in inducing gonads. The most effective dose is 5% for one hour exposure which yields cases of 24.24% of gonad induction.

The efficacy of the above experiments lies in the fact that nucleic acids are not only capable of initiating the totipotent cells into egg-cells but also sperm-cells.

19. Induction of hyperplasia in the body-wall of hydra following Ethyl-Urethane treatment.

SIVATOSH MOOKERJEE and SUNIL DATTA, Calcutta.

Urethane is carcinogenic in its action and some of the cells of hydra have characteristically an innate property of plasticity. These two facts, namely, carcinogenic effect and plasticity of cells of hydra, will make it convenient to bring them together experimentally and to study the effects produced out of their interactions.

Animals were exposed to the effects of 0.5% and 0.75% for 1 to 10 minutes. The morphological changes consist of temporary contraction of body and tentacles. Cellular changes are generally of three types. A condition of hyperplasia is achieved both in ectodermal and endodermal cells, the latter sometimes obliterate gastrocoel. Extensive vacuolization is also observed in both layers and pinching out of enucleated cytoplasmic fragments in the cavity of the coelenteron have also been encountered. The totipotent interstitial cells have been found to increase in their number by a phenomenon of induced divisions.

20. Regionality in the inductive power of hydra tentacle

SIVATOSH MOOKERJEE and ARUP SINHA, Calcutta.

Inductive potencies of different levels of hydra tentacle material have been experimentally studied. Nine sets of experiments have been performed which concern with the removal of various lengths of the tentacles and their implantation as graft at the different heights of the host. Only in the case, where the tentacle excised from the basal region, i.e., the region near the hypostome, is grafted in the middle region of the host, positive induction results.

Histological check-up reveals that in case of a positive induction, ectoderm, mesoglea and endoderm of the graft merge with the corresponding regions of the host and a large number of interstitial cells make their appearance in the grafted material. But in the case of a negative induction, it is seen that mesoglea of host and graft remain separate and a few interstitial cells appear in the graft. Normally the graft material does not contain interstitial cells. The appearance of interstitial cells in the graft, after implantation, has been taken as an instance of migration from the host tissue. The most significant point is that the entire growing tissue is devoid of prolific mitotic activity, though a few amitotic divisions are encountered.

The study depicts a regional distribution of inductive power in tentacle material of hydra.

21. Some aspects of determination in the bud of hydra.

S. N. NAGARAJAN, Calcutta.

Experiments were designed to see whether the polarity in bud of hydra could be altered by appropriate graftings. Buds and mainly parts of buds were grafted in two ways. In one set, normal hypostome end of bud was allowed to remain as the free end of graft and in the other hypostome end of graft was implanted in host

as to make the basal disc end the free end. But in all cases the original polarity was never found to be altered. The experiments reveal that even at the very early stages of bud-formation, the polarity is rigidly and irreversibly determined indicating at least one aspect of intrinsic determination in the bud of hydra.

22. Irreversibility of differentiation of implanted material in hydra.

ARUP SINHA, Calcutta.

Dual capacity of differentiation of middle piece of hydra has been shown by Mookerjee (in Press). This material as an implant in anterior region differentiates into basal disc and in posterior region into hypostome. Existence of this dichotomy in differentiation (basal disc-wise and hypostome-wise) is further analysed to gain information in regard to the property of determination achieved after its implantation.

After producing a basal disc by implanting a middle piece on the anterior region of another hydra, following four sets of experiments were performed: Exp. 1—Host hypostome was excised from sub-tentacular region. Exp. 2—Host basal disc was excised. Exp. 3—Host hypostome and the induced basal disc were removed. Exp. 4—Host hypostome, host basal disc and induced basal disc were removed.

All materials after 72 hours of amputation regenerated their normal structures. The reappearance of a secondary basal disc in place of the induced basal disc forces one to conclude that the inherent property of middle piece has been finally determined and it has lost its range of other differentiation.

HELMINTHOLOGY

23. On Two Genera of Trematode Parasites of a Fresh-water Tortoise.

S. S. AHILWALIA, Mathura.

A specimen of *Emyda granosa* available for examination at Aligarh was found to harbour numerous specimens of the genus *Astiotrema* Looss, 1900, besides a single specimen of the amphistome, *Stunkardia dilymphosa* Bhalerao, 1931. The genus *Astiotrema* has, in all twenty-two species, of which fourteen have been described from India—twelve from fresh-water tortoises and two from fresh-water fishes. Of these, Yeh Liang-Sheng and Fotedar (1958) have recognised only four species of which descriptions have been appended with the other species listed as their synonyms. For differentiating these four species, the authors have relied on the relative size of the two suckers and the posterior extent of the intestinal caeca and the vitellaria. The present author is in full agreement with this arrangement which appears to be quite rational and in conformity with the habits and habitats of the host species. The present specimens have been briefly described, and referred to (Looss 1899) Looss, 1900. *Astiotrema geomydia* Siddiqui (1958), also described from a fresh-water tortoise from Aligarh, has been reduced as a synonym of *A. impletum* (Looss, 1899) Looss, 1900.

The specimen of *Stunkardia dilymphosa* has also been briefly described as the earlier descriptions of Bhalerao (1931) and Chatterjee (1936) contain some variations particularly in regard to some details of the reproductive systems, viz. presence of a yolk-reservoir, a receptaculum seminis, and a cirrus pouch as also the position

of the uterus besides the extremely sinuous character of the intestinal caeca. The generic concept, as outlined by these two authors and Yamaguti (1958), would consequently require some degree of amendment which has also been suggested in the paper.

24. On synonymy, incidence and treatment of *Ogmocotyle indica* (Bhalerao, 1942), Ruiz, 1946.

V. P. SHARMA DEORANI, Izatnagar, (U.P.).

Skrjabin and Schulz (1933) and Yamaguti (1933) separately created two genera *Cymbiforma* and *Ogmocotyle* for almost similar type of notocotylids. By virtue of earlier publication *Ogmocotyle* becomes the valid genus and according to the revision by Ruiz (1946) *Cymbiforma indica* Bhalerao, 1942, should be *Ogmocotyle indica* (Bhalerao, 1942) Ruiz 1946.

Ogmocotyle indica infection is widespread in U.P. hills and is observed generally at heights above 4,500 to 5,000 feet. In a limited survey carried out, the incidence of this infection was found to be 28.9% (51 out of 176) in sheep and goats and 1.2% (1 out of 83) in cattle. Out of 318 terrestrial snails, 52 slugs and 397 aquatic snails examined from these areas none was found positive for the larval stages of the parasite.

Carbon tetrachloride was found to be more effective than hexachlorethane, but Phenothiazine was ineffective. There was slight gain in weight and improvement in general health of the animals of the experimental group. The drugs, though used in high doses, were well tolerated by the animals and there was no mortality during the experiment.

25. Studies on the life history of *Ceylonocotyle scoliocoelium* (Fischöder, 1904), Nasmark, 1937, an amphistome parasite of sheep and goats.

R. P. MUKHERJEE, Izatnagar (U.P.).

The life history of *Ceylonocotyle scoliocoelium* which has been elucidated for the first time is incorporated in this paper.

Aquatic snails of the species *Bithynia pulchella* have been found to act as its natural intermediate host. In the laboratory when clean snails of the species *Indoplanorbis exustus*, *Gyraulus convexiusculus*, *Lymnaea luteola* f. *australis*, *I. acuminata* f. *typica*, *Bithynia pulchella*, *Melanoides scabra*, *Vivipara bengalensis* and *Pila* sp. were exposed to miracidia, development took place in specimens of *B. pulchella* alone. During a survey it was detected that 1.6% to 17.7% specimens of *B. pulchella* were naturally infected with the cercariae of *C. scoliocoelium*.

The miracidium took 11 to 12 days to hatch, except during severe winter months when it took 18 to 20 days. At 32° to 35°C in an incubator hatching occurred in 9 to 13 days.

The following were found to be the distinguishing characters of the cercaria : presence of diffuse pigment on the dorsum, oesophagus with distinct oesophageal bulb, two main excretory trunks having a cross-connection, each excretory trunk provided with one lateral diverticulum in the region of the eye spot, median diverticulum absent, cross-connection forming two loops with the two main excretory trunks, simple caecae and distinct genital rudiments showing the typical arrangement found in the adult.

The snails discharged cercariae in 30 days after experimental infection. The adult parasite was raised experimentally in clean goats. The faeces of the experimental animals became positive for the eggs of the amphistome 173 days after infection.

The detailed descriptions are of the development of the miracidium, morphology of the miracidium, morphology of the sporocyst, morphology and development of the redia, morphology of the cercaria, metacercarial stages together with that of the adult parasite recovered from the hosts.

26. Studies on the life history of *Cotylophoron indicum* Stiles and Goldherger, 1910, an amphistome parasite of buffaloes, sheep and goats.

R. P. MUKHERJEE, Izatnagar (U.P.).

Cercariae indicae XXVI Sewell (1922) has been proved to be the larval form of *Cotylophoron indicum*. *Indoplanorbis exustus* has been found to be commonly infected with the cercaria at Bareilly. The percentage of infection in the snails collected from different localities varied from 11.7% to 50%.

During winter months miracidium took 17 to 20 days to hatch, but in an incubator at 34° to 36°C hatching took place in 10 to 15 days.

The prepatent period of the cercaria in experimentally infected snails varied from 30 to 36 days. A clean goat was experimentally infected. The faeces of the animal became positive for the eggs in 151 days after the infection.

Brief descriptions of the cercariae and rediae and detailed descriptions of the other larval stages and of the adult parasite are given.

27. *Cercaria bhaleraoi*, n. sp., and *Cercaria mathurapurensis*, n. sp.,—two new amphistome cercariae from *Indoplanorbis exustus*.

R. P. MUKHERJEE, Izatnagar (U.P.).

While examining locally available aquatic snails for amphistome infection, a few amphistome cercariae were encountered, including two new ones. Both the cercariae were obtained from *Indoplanorbis exustus*. The main characters of *Cercaria bhaleraoi*, n. sp., are: body pigment in the form of black patches distributed all over the dorsal surface of the body, subterminal oral sucker, the cross-connection together with the median diverticulum of the excretory canals forming a 'Y' shaped structure, each excretory trunk provided with one lateral diverticulum in the region of the eye-spot, the excretory granules arranged in groups leaving behind a space between them, eyes consisting of large dark black patches of pigments. Two generations of redia were observed and the gut of the redia was lined by large cells.

The main characters of *Cercaria mathurapurensis*, n. sp., are: the black pigment located only in the anterior half of the body, a large portion of the posterior part and a little portion of the anterior part of the main excretory canals devoid of excretory granules, cross excretory connection absent, main excretory trunks much coiled, and oral pouches present.

Of these two cercariae *C. bhaleraoi* belongs to "Pigmentata" group and *C. mathurapurensis* to "Diplocotylea" group.

The descriptions of these cercariae, their redial parthenitae and metacercarial stages are incorporated in this paper.

28. Studies on the life history of *Gigantocotyle explanatum* (Creplin, 1847) Nasmark, 1937, a common amphistome parasite in the bile duct and gall bladder of buffaloes.

R. P. MUKHERJEE and H. D. SRIVASTAVA, Izatnagar (U.P.).

The paper deals with the life history of *Gigantocotyle explanatum*.

The miracidium took 11 to 12 days to hatch during the months of July to October and 21 days during November to December. During peak summer months the percentage of hatching decreased to a considerable extent, when kept in an incubator at a temperature of 32° to 35°C hatching began on the 8th day and continued upto the 15th day.

The study of cercaria revealed the following characteristics : presence of diffuse pigment on the dorsum, two main excretory trunks having a cross-connection and each provided with one lateral diverticulum in the region of the eye spot, median diverticulum, simple oesophagus and caecae, large acetabulum and distinct genital rudiments showing the typical arrangement found in the adult.

Among the locally available species of snails only *Gyraulus convexiusculus* was found to act as its natural as well as experimental intermediate host. 0.52% to 4.1% specimens of *G. convexiusculus* were found naturally infected with the cercariae of *G. explanatum*. In experimentally infected snails the prepatent varied from 29 to 34 days.

The adult parasite was raised experimentally in clean goats. Their faeces became positive for the eggs of the parasite in 151 to 161 days after the infection.

Details descriptions are given of the development of the miracidium, morphology of the miracidium, morphology and development of the sporocyst and redia, the development of pigment and of other organs of the cercaria and its morphology, metacercarial stages and the morphology of adult amphistome recovered from the experimental animals. The systematic position of the parasite has also been discussed.

29. Studies on Furcocercous Larval Trematodes from India. Part II.—Aporocotyloid and Sanguinicolid Cercariae.

R. N. SINGH, Raipur (M.P.).

In part I of this series of studies, the author gave a critical review, inter-relationships and taxonomy of furcocercous cercariae belonging to the Order Strigeatoidea La Rue, 1926. The present paper gives an account of furcocercous cercariae belonging to the blood-fluke families Aporocotylidae and Sanguinicolidae. The group in India is represented by *Cercariae indicae* IX, XIII, XXXIX, LV (all of Sewell, 1922); *C. magnacristata* Premvati, 1953, *C. robertsoni* Patki, 1956, and *C. luteoli*, Srivastava, 1959.

From the work of Odhner (1911), Eismont (1925), Scheuring (1922), Wales (1958) and Erickson *et al* (1959) on blood flukes of fishes (Aporocotylidae-Sanguinicolidae); Hunters (1934-35), Krull (1934) and Singh (1959) on life history of Clinostomes (Fam. Clinostomatidae) and Wall (1939, 41 and 51) on the life-cycle of blood flukes of turtles (Fam. Spirochiidae), it has been fully established that Lophocercariae belong to the above three families of Digenea. The three groups of cercariae possess characteristic features of their own, and are related to one another. Lophocercariae with eye spots, which develop in rediae, lack furcal fin-folds and possess a rhabdocoel gut, outline of ventral sucker and flame cells in tail constitute the "Clinostome Group". Lophocercariae possessing a typical body fin-fold, furcal fin-fold, develop in sporocysts lack a gut and ventral sucker, flame cells in tail and may or may not have eye spots, form the group of "Aporocotyloid

and Sanguinicolid Cercariae". The cercariae of the Spirorchiidae have an atypical body fin-fold which has a central cavity, furcal-fin-folds, gut, eye spots flame cells in tail and develop in sporocysts.

In view of the above findings, it is suggested that the *taxa* Lophocercariae of Lühe (1909) and Lophocerca of Sewell (1922) originally considered as Monostomes should be dropped and be used only for descriptive purposes as they have lost their taxonomic significance in present stage of our knowledge.

The conviction that the blood flukes originated in the Amphibian and Reptilian hosts as members of the family Spirorchiidae and from Reptile they pass on into the avian and mammalian hosts along one line of evolution as members of Schistosomatidae and into the piscine hosts along the other line as members of the Aporocotylidae and Sanguinicolidae is fully supported by life history studies during recent times.

The general character of the group Aporocotylid and Sanguinicolid and its phylogeny has been discussed.

30. A preliminary survey of the nematode parasites of sheep and some of the types of helminthic lesions encountered.

B. B. BHATIA, Mathura.

During the period mid-June to mid-September, 1959, a collection of round-worms and such morbid material as was suspected to be helminth infested was made daily from the local slaughter-house where sheep for slaughter are also brought from the adjoining districts of Agra and those of Rajasthan, viz., Dholpur, Bharatpur and Alwar. The present collection of nematodes is represented by the following twelve species:—*Haemonchus contortus*, *H. longistipes* and *Trichostrongylus colubriformis* from abomasum; *Bunostomum trigonocephalum*, *Capillaria* sp. and *Gaigeria pachyscelis* from small intestine; *Oesophagostomum columbianum*, *Trichuris globulosa* and *T. ovis* from large intestine; *Gongylonema pulchrum* from oesophagus; *Protostrongylus rufescens* from lungs and *Onchocerca armillata* from aorta. A capillariid infection in sheep, as far as known, is a first Indian record.

The suspected helminthic lesions have mostly been encountered in the mucosa of (i) the abomasum due to trichostrongylid infestations e.g. *Haemonchus*, (ii) duodenum due to embedded scolices of immature anoplocephalids, (iii) small intestine on account of hookworms and (iv) large intestine, as also its submucous part, due to trichurids nodular worms and the blood flukes, with the adult worms or their developmental stages. Marked pathological changes were noticed in (i) liver due to *Schistosoma indicum* and hydatid larva, (ii) lungs on account of protostrongylid and larval taenids and (iii) aorta due to onchocercal infections, the latter has been recorded for the first time from this animal.

Besides, during an examination of sheep at the slaughter-houses of Nainital and Almora in November 1958, *Cocperia punctata* in duodenum, *Chabertia ovina* in small intestine and *Dictyocaulus filaria* in bronchi in Hill sheep were also encountered. A Polworth lamb at Govt. Sheep Breeding Farm, Karni (Almora) has been found to harbour *Nematodirus spathiger* in its small intestine.

The various stages of the two species of lungworms have been studied in detail. The free-living phase, in addition to the development of embryonated eggs of *D. filaria*, *in vitro*, has also been followed up in the laboratory. The characteristic differences of the larvae have also been dealt with. A survey embracing the faunistic part with a study of the related pathological material, encountered in natural

infections, has been made for the first time. Pulmonary infection with linguatulid nymphs is also reported.

31. Incidence of nematode in jute and allied fibre crops.

N. DUTT, Barrackpore.

Jute nematode *Heterodera marioni* (Cornu) Goodey (= *Meloidogyne incognita* (Kofoid & White) Chitwood has been found to cause root-knot diseases in almost all the known varieties of *Corchorus capsularis* (bitter jute) and *C. olitorius* (non-bitter jute). This includes seventeen *capsularis* and five *olitorius* types. When grown in infected soil, they take up nema-infestation within a week after germination. In a pot trial with known nematode infested soil, three *capsularis* types, viz. JRC-212, D154 & Panduk, and three *olitorius* types, viz. JRO-632, JRO-620 & C. G., were tested for their relative susceptibility to the pest. None of these varieties showed much difference in their intensity of incidence till 75 days. During the later part of growth, *capsularis* types showed higher incidence than *olitorius* ones. This may be due to the more development of fine roots and their spread near the surface soil which represents the zone of highest distribution on the nematode as has been ascertained from observations made on the depth distribution of the pest. Little over 50 per cent of the parasitic population has been found up to a depth of 10 inches from the surface while the depth of 6—7 inches represents the zone of maximum population density where nearly $\frac{1}{4}$ of the total population was found. This also indicates that in case of soil fumigation, it should be applied at a depth 6—7 inches below surface. The parasite may exist at depth of 2 ft. below from surface. Nematode population was, however, higher in samples collected during the months of May and June. It has been observed that the infested plants can often grow normally with root-galls without showing any noticeable malformations on leaves, stem or on the reproductive phase or seed production. Fibre crops allied to jute, viz. *Hibiscus cannabinus* (mesta) and *H. sabdariffa* (rosella), were also tested for their susceptibility. While mesta (MT-102) showed high degree of susceptibility to the parasite like jute, roselle (RT-26 and RT-2), showed high degree of resistance with comparatively negligible intensity of infestation.

32. Effect of high temperature on the Life-cycle of *Strongyloides papillosus* (Wedl. 1856).

PREMAVATI, Lucknow.

Strongyloides papillosus is a common parasite of sheep and goats with wide distribution in tropical and temperate zones. For experiments, twenty sheep guts were dissected per week for a period of six months. Infection of sheep with *S. papillosus* in Lucknow area was found to be 90%. The cultures were made from the adult parthenogenetic females and their eggs collected directly from the intestinal contents, and maintained at different temperatures between 30°C and 50°C. The optimum temperature of complete development was found to be 34°C, which gives predominantly indirect mode of life-cycle. At a temperature of 40°C, only 2—3% of the hatched eggs develop directly into infective larvae; the mortality rate being very high at this temperature. Temperatures of 45°C. and above are completely lethal to these eggs, and no hatching takes place. Inhibition experiments at 40°, 45° and 50°C were also performed. The results of these experiments are illustrated by graphs and tables.

33. On the nematode fauna of local goats with remarks on natural infections of some of its pathogenic helminths.

S. M. SOOD, Mathura.

More than thirtyfive species of roundworms are so far known to parasitize goats in India. During the routine collections made daily in the months of July, August and September, 1959, from the slaughter house where indigenous goats are slaughtered, the nematode material has been found to represent the species :— *Haemonchus contortus*, *Trichostrongylus colubriformis*, *Cooperia punctata*, *Gaigeria pachyscelis*, *Bunostomum trigonocephalum*, *Oesophagostomum columbianum*, and *Protostrongylus rufescens* among the Strongyloids; *Trichuris ovis*, *T. ovina*, *T. globulosa* among Trichinelloids; *Gongylonema pulchrum*, a Spiruroid; *Onchocerca armillata*, *Setaria* sp. and a dipetelonematid filarioid (recently reported, along with onchocerciasis, from this Department and has provisionally been identified as *Tetrapetalonema* sp.) among the Filarioids.

Of all these fourteen species, it is in connection with infestations of the trichostrongylid—(*H. contortus*), hook-worms (*G. pachyscelis*, *B. trigonocephalum*), nodular worms (*O. columbianum*), lung-worm (*P. rufescens*), whip-worms (*T. ovis*, *T. globulosa*) and filarial worms (*O. armillata* and the dipetelonematid), that specific lesions have been studied and described in the present paper.

In addition, the present collection has also supplied pathological material associated with blood-fluke infestation (*Schistosoma indicum*) of liver and caecum, immature anoplocephalids in duodenum, larval tape worms (hydatid and cysticercus) and pulmonary infection with the non-helminthic parasite—a tinguatulid (nymph). A detailed microscopic study of such material has provided important data on the resulting changes associated with these specific infestations in the host tissues which are also incorporated in this paper.

34. On the nematodes parasitic in some wild aquatic birds.

J. S. SRIVASTAVA and P. RAI, Mathura.

Specimens of *Ardeola grayii* (the pond heron), *Ceryle rudis* (the pied kingfisher), *Egretta garzetta* (little egret), *Halcyon smyrnensis* (the white-breasted kingfisher), *Himantopus himantopus* (the black-winged stilt) and *Ibis leucocephalus* (the painted stork) were examined post-mortem during the months from July 1958 to April 1959 for a survey of their nematode fauna. The species of nematodes met with are listed below under the hosts with their location : *A. grayii*; (i) *Porrocaecum reticulatum* (Linstow, 1899) Baylis and Daubney, 1922 (intestine) and (ii) *Contracaecum tricuspe* (Geddes, 1916) Baylis, 1920 (oesophagus); *C. rudis*; a species of *Proleptus* Dujardin, 1845 (gizzard); *E. garzetta*—(i) *Porrocaecum reticulatum* (Linstow, 1899) Baylis and Daubney, 1922 (intestine), (ii) *Synhimantus* (*Desportesius*) *canadensis* Mawson, 1956 (proventriculus gizzard) and (iii) *Tetrameres spinosa* Maplestone, 1931 (proventriculus); *H. smyrnensis*—*Habronema indica* Maplestone, 1929 (gizzard); *H. himantopus*—(i) *Amidostomum skrjabini* Boulenger, 1926 (gizzard) and (ii) *Tetrameres spinosa* Maplestone, 1931 (proventriculus); and *Ibis leucocephalus*—*Capillaria columbae* Rudolphi, (1819) Travassos, 1915 (oesophagus).

A perusal of available literature on the host records for these eight species reveals that, except for *P. reticulatum*, in all others the present collection establishes new records. The genus *Proleptus* has so far seven species all of which occur in fishes. This is the first record of the occurrence of the genus in an aquatic bird. The present paper gives a brief description of these species incorporating the important differences from the existing accounts as also some of the pathogenic effects observed at the seats of predilection.

35. On the occurrence of *Habronema muscæ* (Carter, 1861) in the heart of a pony.

J. C. TRIPATHI, Izatnagar (U.P.).

During the course of the post-mortem examination of a pony at the local Veterinary Hospital, a large number of Spirurid worms were recovered from the stomach and the right auricle of the animal. The nematodes on examination were found to be specimens of *Habronema muscæ*. The common occurrence of this parasite in the stomach of equines is well known. But its occurrence in the heart has not been recorded previously. Nine adult specimens—two males and seven females—were found in the right auricle.

36. The occurrence of *Pallisentis basiri* Farooqi (Acanthocephala) in the liver of *Trichogaster chuna* (Ham.).

R. HASAN and S. Z. QASIM, Aligarh.

All species reported so far belonging to the genus *Pallisentis* are from the guts of fresh water fishes. In *Trichogaster chuna* (Ham.) a newly reported species, *Pallisentis basiri* Farooqi (1958) from *Rhynchobdella aculeata* (Bloch), has been noticed to parasitize the liver. No infection in the alimentary canal was seen in this fish. In the liver, the parasites lie in an encysted condition and the cysts could be distinguished externally. They measure 0.5 mm. to 1.5 mm. in diameter and contain mature worms.

The chief animal food of the fish being cyclops and daphnids, it seems probable that the infection reaches through the ingestion of one of these organisms.

The encysted nature of the worms in the liver and the absence of free stages from other organs, raises another possibility. The fish might be acting simply as a "reservoir host". Parasitic adaptations of this kind have been reported earlier in the Acanthocephala and in such cases the worm requires another "definitive host" to complete the rest of its life-cycle.

ANNELIDA

37. Observations on the Behaviour of Some Land and Aquatic Leeches—II.

B. D. BHATT, Gorakhpur.

Observations made on the biting behaviour of *Haemadipsa zeylanica agilis* in June show that this leech takes about eight minutes to puncture the human skin after it has attached its anterior sucker to the site of biting. On removal of leech from the site at this stage flow of blood from the wound made by the leech continues for two to twenty minutes. In July when the leeches become very active the time to make the puncture on the body is reduced to 3–5 minutes. Period of bleeding from the wound made by the leech is directly proportional to the period for which the leech sucks the blood. This is probably due to the fact that as the leech sucks blood, it at the same time injects the anticoagulant and histamine substances which encourage bleeding. The bite of *Haemadipsa montana* is slightly painful, whereas the bite of *Haemadipsa zeylanica agilis* is more or less painless.

Land leeches—*Haemadipsa zeylanica agilis* and *H. montana* have been found to feed on mammalian blood only. They have been noticed sucking blood of man, dog, cat, rat, cow, mole and guinea pig. *Herpobdelloidea lateroculata* has been

observed ingesting algal filaments, indicating its herbivorous nature. *Barbronia weberi* feeds on micro-oligochaetes.

During respiratory movements of *Hemiclepsis marginata marginata* the suckers remain fixed to the substratum and waves of contraction of body pass from anterior to posterior end of the body.

Glossiphonia weberi and *Hemiclepsis marginata marginata* take care of their brood in the concavity developed on the ventral side of the body by the downward curling of the sides of the body. If the brood is very big it is put on the substratum during respiratory movements of the parent.

38. On Some Fresh-water Leeches from Kumaon (U.P.).

B. D. BHATT, Gorakhpur.

Leeches were collected from ponds, lakes and streams. The following leeches belonging to the family Glossiphonidae were collected.

Placobdella ceylonica, Harding.—This is the first record of this species from Uttar Pradesh. The colour of body is green. The proboscis is long and forms a long loop in retracted state.

Hemiclepsis marginata marginata, O. F. Mueller is a common species in the lakes of Naini Tal District. *Hemiclepsis marginata asiatica*, Moore has been recorded for the first time from Naini Tal lake.

Glossiphonia weberi, R. Blanchard is also common species in the lakes of Kumaon. The male and female gonopores, whose positions were controversial, have been found to open by a common pore at XI/XII.

Helobdella gracilis for the first time recorded in Java by Blanchard (1897) has also been recorded from Naini Tal lake.

The following species belonging to the family Erpobdelidae have been recorded.

Barbronia weberi, Blanchard is found in abundance in the lakes and streams of Kumaon. The cocoons are laid in autumn.

Herpobdelloidea lateroculata, Kaburaki has been recorded for the first time in U.P. from Bhim Tal and Sat Tal lakes. Great variations have been noticed in the shape of crop and intestine in the different specimens of this species.

Dinobdella ferox, Blanchard, the only leech belonging to the family Hirudidae is commonly found in pools and streams in Kumaon. It is a very serious pest of cattle in Kumaon. The specimens collected differ from the description of this species by Moore (1924) in following respects.

1. The colour is grey to slaty-brown but never dark green.
2. The reproductive organs are not much slender.
3. The difference in size of free-living and parasitic forms is too great.

39. Preservation of Earthworms for Class Demonstrations.

G. S. GHOSH, Puri and B. K. BEHURA, Cuttack.

A technique for the preservation of earthworms (*Pheretima*) for class demonstrations of the general external features, alimentary, nervous and reproductive systems is given.

1. Wash the fresh earthworms well to remove any dirt sticking to their bodies.

2. Keep the specimens in a trough with sufficient water to cover them.

3. Allow methylated spirit to drip very slowly into the trough for one to one and half hours.

4. Stretch the earthworms by pinning them at the anterior and posterior ends in a dissection tray.

5. Cover the specimens with 5% formaldehyde and leave overnight.

6. Roll 25 to 30 treated specimens in blotting paper and preserve in a solution of : 70% glycerine 25 parts, 90% alcohol 70 parts and 5% formalin, 5 parts.

Before dissection, the specimens should be washed and softened under running tap water for half hour to one hour.

For an examination of the blood-vascular system, however, specimens freshly killed with chloroform vapour should be used and for an examination of nephridia, a fresh worm or one killed in spirit or chloroform should be used.

CRUSTACEA

40. Some New Isopod Parasites on Fishes.

U. N. JOSHI and D. V. BAI, Bombay.

The paper deals with the systematic account of three new Isopod parasites on fishes. The detailed account of the systematic position of *Argathona muraeni*, Sp.n., *Nerocila pigmenta*, Sp.n., and *Cymothoa cinerius*, Sp.n., is discussed in this paper.

ENTOMOLOGY

41. A note on the bacterial disease of *Nephantis serinopa* Meyrick, a Lepidopterous pest of the coconut palm.

J. ANTONY and CHANDY KURIAN, Kerala.

During the rainy season when the mean R.H. is very high, (about 95%) death of a large number of *serinopa* larvae was observed in the laboratory cultures at the Central Coconut Research Station, Kayangulam (Kerala). Similarly large-scale death of larvae and pupae of *Plusia peponis*, *Margaritia indica* and *Sylepta doogata* was also noticed. The causative organism was isolated and identified as *Serialia marcescens* Boizio. It consists of small gram-negative rods which usually produce characteristic pink pigments. The infected larva becomes sluggish in movement and upon death acquires the characteristic pink colour and when it disintegrates, turns brownish and finally blackens. The body of the larva loses its shape, turgidity and rigidity immediately after death, because of the liquifaction of the body tissues. Preliminary infection trials with the bacterial suspension caused the death of more than 70% of the larvae experimented with, within five days, although mortality starts 24 hours after inoculation. Some of the larvae which pupated also succumbed to the bacterial infection. In general, it was observed that the bacterium produced fatal infection when inoculated into the larvae and when given by ingestion. The pathogenicity was observed varying depending upon the stage of the larvae. Pupae and moths were also observed to be killed by this pathogen.

42. Effects of Nicotine Smoke on the Reproduction Pattern of *Bruchus* Sp.

S. BANARJEE, Calcutta.

The effects of toxic substances on the reproduction of animals is now well known. Studies have been made to analyse quantitatively the effects of nicotine smoke on the egg-laying and viability of *Bruchus* sp. under experimental condition.

The male and female specimens have been exposed to nicotine smoke for varying length of time and allowed to breed in captivity. Results obtained show that although mating time is increased upto some duration, it is subsequently decreased. Following total number of eggs laid, frequency of egg laying, and viability, show unidirectional inhibition resulted by increasing exposure time.

The factors of duration of treatment of nicotine smoke on the different phases of reproduction are discussed.

43. Systematic position, host preference and distribution of *Perisierola nephantidis* Muesebeck (superfamily Bethyloidea, family Bethylidae, a larval parasite of *Nephantis serinopa* Meyr.) and its allied species.

CHANDY KURIAN and J. ANTONY, Kerala.

Bethylids are exclusively parasitic, the host being the larva of some of the lepidoptera and coleoptera. *P. nephantidis* has a very wide distribution especially along the East and West Coast of India and Ceylon, where *N. serinopa* is prevalent as a pest of the coconut palm. This parasite, though effective in controlling the pest, has a few hyper-parasites viz., *Calliceras manilae* Ash., *Eurytoma albolibialis* Ash. and *Plcurotropis* sp. which was later on identified as *Pediobius* sp. From the Indo-Australian region, so far only five species have been described including *P. nephantidis*. *P. angulata* Muesebeck, parasitic on *Grapholitha molesta* Busck, is Australian; *P. mellipes* Muesebeck from unknown host, *P. pulveriae* Kurian, parasitic on *Holcocera pulverea* or *Tachardia lucca*, *P. salvadorae* Kurian, collected from Psyllid galls and *P. nephantidis* from *Nephantis serinopa* are Indian species. *P. emigrata* Rohwer, a sixth species from Hawaii attacking *Cryptophlebia illepidia* and *Pectinophora gossypiella* has a very great resemblance to *P. nephantidis*. The paper is concluded with a key for the Indo-Australian species of the genus *Perisierola*.

44. Sexual Dimorphism in *Dysdercus Koenigii* (Fabr.).

N. B. CHATTERJEE, Burdwan and D. N. RAYCHOU DHURI, Calcutta.

Biometrical analysis of nine specimens of each sex regarding the different characters reveals that the females are longer than the males at 0.1 per cent level and the differences in length is chiefly due to length of the abdomen at 5.0 per cent level; rostrum and hind-wing of females are much longer at 1.0 and 5.0 per cent levels respectively. The longer hind-wings in females are perhaps for covering long abdominal region.

Besides these differences in measurements the males differ from females in having three spines and a long slender hair at the base of the antenna and only four conical spines on the inner margin of the first femora. Further the males are characterised in having only nine abdominal segments and not ten as found in females and also by the absence of a pair of apertures on the middorsal region of the abdomen.

Internally the males are peculiar in not having gastric caeca almost at the junction of third midgut and hindgut as found in females.

45. Life History of *Dysdercus Koenigii* (Fabr.).

N. B. CHATTERJEE, Burdwan and D. N. ROY CHOU DHURY, Calcutta.

Experiments were conducted during the period, December to April, to study the life-cycle of *D. Koenigii* in the laboratory. The period included 5 to 7 days,

2 to 4 days, 6 to 8 days, 9 to 11 days, 6 to 7 days and 4 to 5 days for the emergence of the first, second, third, fourth, fifth and adult stages respectively.

The rate of development varies directly with average relative humidity and inversely with average temperature e.g., 12.2% and 2.6% of adults emerged at an average minimum temperature of 14.5°C and 22.7°C at an average relative humidity 41.0% and 28.6% respectively.

The alcohol preserved eggs were elliptical in shape, with a highly polished and reticulated surface, and with elongated oval projection arranged in a trapezoid fashion at one pole. The first and second nymphal stadia were spent underground feeding on decaying matter or when inside the food capsule feeding on the sap of the fibres. From third nymphal stage they begin to attack plants.

In microscopic preparation the average length of the body of first, second, third, fourth, and fifth instars were 1.21 mm., 1.58 mm., 2.82 mm., 2.70 mm. and 5.20 mm. respectively. The ratios of the length of the rostrum and the antenna to the length of the body of the different stadia were also studied. The distinguishing characters of different stadia are discussed in the paper.

46. Biology of *Dysdercus Koenigii* (Fabr.).

N. B. CHATTERJEE, Burdwan and D. N. RAY CHAUDHURI, Calcutta.

During the period of observation (1957-58) the insects were found in clusters, in West Bengal throughout the year, chiefly as a pest of Cotton (*Gossypium* spp.). Beside this, the species was noticed to attack different plants of the N. O. Malvaceae e.g., *Allhea rosea*, *Bombax malabaricum*, *Hibiscus esculentus*. The insects could be collected more in the morning and late after-noon than during the rest of the day, when they hide themselves under the shady and moist places. The insects from the third instar onwards imbibed the plant sap, mostly from the fruits, seldom they sucked the sap from the stems and ventral surface of leaves. From section of the cotton ball with inserted stylets it can be said that the stylets follow a zigzag course during the process of insertion. In the natural process of suction, the fruits became dry followed by the coming out of brown fibres. Majority of the insects were collected in copula from October to April, on *Gossypium* spp. The eggs were laid either under the debris of leaves on the ground or in the space between the fruits and sepals.

In laboratory pre-copulation period was observed to vary from four to eight days in different experiments conducted at different periods. The insects were found in a copulating condition for three days in laboratory as compared to two days in the field. The males were noticed to copulate more than once in a day. The eggs were laid 3 to 5 days after the first copulation, in batches, maximum number of which were 3 consisting, on the average, 70 to 90 eggs.

The insect was found in association with *Solenopsis* sp., *Antilochus cocuerberti* (Fabr.) a spider, and a Reduviid bug; the last three were noticed to attack this insect. An internal helminth parasite was noticed in the body cavity of females.

The insects were found to be negatively phototropic.

47. Efficacy of Organic Phosphate Insecticides, Diazinon and Malathion, in the Control of the Cattle Tick *Boophilus microplus* (Canestrini).

R. P. CHAUDHURI, Izatnagar (U.P.).

Because of the development of resistance to the arsenic and the chlorinated hydrocarbon insecticides in the cattle tick and other important species of ticks affecting livestock in various parts of the world, attention has been shifted, these

days, from these to the newer organic phosphate group of insecticides for the control of these ticks. In a trial against the cattle tick *Boophilus microplus* (Canestrini) treatments with 0.05% diazinon, 0.5% malathion, and 0.5% DDT mixed with 0.025% lindane freed the cattle (hill bulls) completely from the tick infestation in two days. The action of treatments with 0.5% malathion and 0.5% DDT mixed with 0.025% lindane appeared to be quicker than that of 0.05% diazinon treatment. The organic phosphate insecticides kept the treated animals free from tick for at least 8 days whereas DDT mixed lindane protected the cattle from tick infestation for at least 29 days. The treatment with 0.05% toxaphene did not make the animals completely free from ticks at any time and was found to be inferior to the other three treatments in this respect. In none of the animals treated with insecticides any clinical symptom of illness that might be attributed to insecticides, was noticed.

48. Studies on the Efficacy of New Organic Phosphate Insecticide Bayer 21/199 in Controlling Demodectic Mange and Tick Infestation of Cattle.

R. P. CHAUDHURI, Izatnagar (U.P.).

The new organic phosphate insecticide known as Bayer 21/199 was tested against demodectic mange and tick (*Ilyalomma savignyi*) infestation of cattle. In the first trial three Haryana calves (12—15 months old) that were suffering from bad pustular form of demodectic mange were treated with the insecticide. The intensity of infestation in the three calves namely calves nos. 1311, 1304 and 1302 was rated for this purpose as heavy, medium and light and these calves were treated with 0.75%, 0.5% and 0.25% of the insecticide respectively. After three applications of the treatments, each at an interval of ten days, calves nos. 1304 and 1302 were found to be cured. The condition of the worst affected calf no. 1311 also was found to have improved markedly but it was not completely cured. The treatment of this calf was still being continued.

In the second trial with the insecticide twentyone buffalo calves (about 12 months old) very heavily infested with tick *H. savignyi* were used. Nine of these buffalo calves were treated with 0.15% and the remaining twelve with 0.25% of the insecticide. It was found that a single treatment with each of the two concentrations of the insecticide killed about 60% of the ticks present on the bodies of the calves.

In both the trials the insecticide was used as wash and no ill effect of the treatment was noticed on any of the treated animals.

49. Studies on the Life-history and Bionomics of the Buffalo Louse *Haematopinus Tuberculatus* Burm.

R. P. CHAUDHURI and PAVAN KUMAR, Izatnagar (U.P.).

The life-history of the buffalo louse *Haematopinus tuberculatus* Burm. was studied by keeping the lice confined inside a metal cup specially made for the purpose and fixed on the body of the buffalo calf. Eggs of the buffalo louse are usually laid in clusters glued on the hairs of the host. Several (6—7) eggs may be found to be attached to a single hair. Eggs are laid mostly on the hairs of shoulders, neck and fore-legs of the host. Incubation period of the eggs has been found to be 12 days in December and 9 days in April. After coming out of the eggs the 1st instar nymph becomes very active and moves about on the body of the host seeking for the thin skinned areas such as inner sides of legs, the neck and belly to feed upon. During the winter months when 4 days old the 1st instar

nymph moults. The 2nd and the 3rd instar nymphal stages last for 3—4 days during November to January. Unlike the first two nymph instars the 3rd instar nymph can be seen to be feeding on the thick skinned areas on the body of the host. Though a female louse can be fertilized shortly after emergence usually the pre-oviposition period varies between 2 and 3 days in March and April. Thus the life-cycle of the louse is completed in about 3-4 weeks. A male louse is capable of fertilizing more than one female louse and as many as 3 females have been seen to be fertilized by a single male in a day. The act of mating has been found to have lasted for $\frac{1}{2}$ - to $1\frac{1}{4}$ hours. The female partner has not been seen to have sucked blood while in copulation but the male partner does so. One to eight eggs are found to be laid by a female louse per day and 62 to 93 eggs in total are laid by a mother louse during her life. Oviposition period varies between 12 and 19 days. Female lice live for 14 to 22 days but males could not be maintained for more than 48 hours inside the metal cell used for keeping the lice confined on a particular part of the body of the host during observation and therefore their longevity could not be determined. Only about 50% of the eggs laid by fertilized female lice were found to have hatched. Unfertilized female lay eggs but the latter never hatch.

The population of the louse on the body of the host is smallest in the month of July. It starts rising in October and reaches its peak number in the winter months of January and February. From March the population begins to fall. Female lice can be seen on any part of the host's body except tail whereas males are usually seen on the back, hind-legs and shoulders of the host.

50. Wing-venation of Coleoptera. Part I. Studies on the wing-venation of five species of Meloidae.

A. K. DATTAGUPTA, H. L. KUNDU and SUSHIELA MUNSHI, Pilani.

The venation of five species of beetles, *Lytta picta* F., *Lytta actaeon* Cast., *Lytta tenuicollis* Pall., *Gnathospathoides rouxi* F. and *Illetica testacea* F. (Lyttninae) has been studied. The chief features of the venation are as follows.

Costa (C) is short. Sub-costa (Sc) forms an elliptical cell (W) with costal margin in *L. picta* and *L. tenuicollis*. The radius (R) with the inner margin of the pterostigmatal area (Y) forms a short radial recurrent (Rr) in all the species. Radials are poorly developed. Media (M) is reduced and is represented in most of the species by a rudimentary medial recurrent (Mr) which joins the cubitus (Cu) by a medio cubital cross vein (m-cu). $M_4 + Cu$ is short. There are four anals. First anal (1st A) when present is represented by a small distal portion of it and gives off branches 1stA₁ and 1stA₂ in *Illetica testacea*. There are two branches of the second anal (2dA) in all the species studied. A cross vein has been observed between Rr and Mr (r-m) in *L. picta*, *G. rouxi* while another between 2dA and 3dA (c-v) in *I. testacea*, *G. rouxi* and *L. actaeon*.

51. Biology of *Neocarbula Capitata*. (Dist.).

V. R. DIKSHIT, Bhopal.

The present study reveals that the insects feed on the leaves of *Oscimum sanctum*. The insects are usually found on the under surface of the leaves of *Oscimum sanctum* and are particularly fond of the leaves found on the lower branches of an old plant. Their number is greatest when the atmosphere is somewhat cool and humid. There is distinct sexual dimorphism. The eggs and the

instars are being collected. The insects were observed as runners. In the laboratory they show negative phototropism.

52. Decline in the seasonal prevalence of *Anopheles stephensi* at Lucknow, U.P.

DIWAN CHAND and H. M. L. SRIVASTAVA, Lucknow, U.P.

A. stephensi has been an important vector of Malaria in U.P. It caused a severe epidemic in the above town in 1929. *A. stephensi* prevailed in large numbers from January—June, while during July—December it occurred in poor numbers. It has been observed for the first time that during 1959 the density of this species went down very low at Lucknow even during the months of January—June. Probably reasons of this decline have been discussed. Further observations are in progress.

53. Variation in the tarsal segment of *Tetraneura hirsuta* (Baker) Homoptera; Aphididae.

A. K. GHOSH and D. N. RAY CHAUDHURI, Calcutta.

A number of workers like Hertig (1841), Baker (1921) and Theobald (1928) have worked with this species. But none of the workers mentioned anything about the variation in the number of tarsal segments of alatae and apterae. The apterae of this species collected from West Bengal are characterised by a single jointed tarsi as has been mentioned by previous workers while the alatae possess two jointed tarsi. This variation in a single species is not known so far. Further investigation is in progress, as to whether the creation of a new subgenus of *Tetraneura* is feasible.

54. Studies on the Odonata of Naini Tal.

S. C. GOEL and S. P. BHATTNAGAR, Naini Tal.

The insect fauna of Kumaon Hills is very rich and has attracted very little attention of entomologists. Our knowledge of Dragon-flies owes a great deal to various workers in this field. The most outstanding contribution is of Fraser.

The present paper deals with the external morphology of *Megalestes major* and *Anax parthenope* and also with the taxonomic description of some of the species so far identified. In this region *Megalestes major*, *Neurorhis chinensis chinensis*, *Anax parthenope*, *Bavadera indica*, *Rhinocypha immaculata*, *Ischnura mildrede*, *Agriocnemis* sp. and *Ceylondestes* sp. are in abundance.

October and November are the best months for the collection of these insects. Unlike many of the authorities who describe these insects as strictly sun loving, we were able to collect them during torrential rains and at dusk along the Kosi river.

55. Effect on yield of peach fruits of DDT and diazinon sprays before and after bud burst against peach leaf curling aphid in the Hills of Uttar Pradesh.

K. M. GUPTA, Chaubattia.

Results of application of DDT emulsion 0.5% to peach trees before bud burst against *Brachycaudus helichrysi* Kalt., at Bhowali (Nainital-U.P.) have been compared with those of diazinon emulsion 0.031% and 0.05%, applied before and after bud burst, respectively, in regard to fruit setting, fruit fall, curling of leaves, yield

of fruits and economics of treatments. Under the conditions of the experiment, applications of DDT and diazinon before bud burst, were practically identical in their effect on setting of fruits and the yield was more than double in both the cases as compared to control (without treatment), but the percentage of curled leaves was, however, higher in diazinon than DDT. High increase in yield justifies regular and compulsory application of DDT or diazinon on peach trees before bud burst. Treatment with 0.05% diazinon soon after bud burst can also improve the yield by about 60%.

56. Woolly Apple Aphid (*Eriosoma lanigerum* Hausm.) and its control in the Hills of Uttar Pradesh.

K. M. GUPTA and L. D. JOSHI, Chaubattia.

Results of research work done on woolly apple aphid at Chaubattia (29° 45' : 79° 40') on varietal resistance of root stock, biological control by *Coccinella septempunctata* Linn. and *Aphelinus mali* Hald., and chemical control, have been presented. Winter sprays of Ekatin 1 : 800 or parathion emulsion 0.05% reduced the population of aerial colonies by over 99%. Application to soil at the rate of one pound per tree of parathion emulsion 0.05%, diazinon emulsion 0.05% or Metasystox 1 : 500, costing 3 to 6 Naya Paisa, exterminated root colonies. To check further spread of the pest, root and aerial colonies should be treated simultaneously and special attention should be paid to trees with cracks and crevices and knotty outgrowths. Knotty plants in the nursery may be discarded and only aphid-free plants allowed to leave nursery.

57. Mode of Ingestion in Rice Skipper (*Parnara Colaca* Mo.) of India (Hesperiidae-Lepidoptera).

KRISHNA K. GUPTA and S. MASIHOO ALAM, Aligarh.

In *Parnara colaca* Moore, the mouth parts are greatly reduced. Mandibles are absent. Maxilla has distinct basal plates. Modified galeae together form the proboscis which is provided with intrinsic oblique muscles. Elastic nature of dorsal inner walls of galeae coils proboscis. Stipes is a hollow tubular structure whose lumen is separated from that of the cranium by a valve. Uncoiling of proboscis is due to change of blood pressure within stipes. Food canal opens into the sucking pump which is a cibarial-cum-pharyngeal pump with cibarium forming its major portion. The floor of the pump is formed by the hypopharynx. The food canal and the sucking pump become continuous as the labral compressor contracts and the cibarial compressor relaxes. Then by the simultaneous contraction of cibarial dilators accompanied by the relaxation of the oblique muscles, the food is sucked up into the sucking pump whence it is forced into oesophagus through the true mouth by the contraction of transverse and oblique muscles accompanied by the antero-posteriorly directed relaxation of the dilators.

58. New hypotheses on the nature of amitosis and its relationship to endomitosis as seen in the development of the small milk-weed bug.

MRS. N. I. JOSEPH, Trivandurm.

A cytological study of the post embryonic development of the salivary glands, alimentary tract and malpighian tubules in *Lygaeus kalmii angustomarginatus* the small milk weed bug shows that during the five instars of its development, mitosis

is completely absent and endomitosis and amitosis occur side by side in all the tissues of the above mentioned organs. Observations on the germ cells and somatic cells of the testes in the imago indicate that the germ cells resort only to mitosis with an evident spindle mechanism while in the surrounding somatic tissue both endomitosis and amitosis take place. Amitosis is similar to that seen in mammalian liver cells and endomitosis to that reported in other heteropteran tissue. In addition binucleate cells in various stages of endomitosis were observed which seemed to indicate that the endomitotic process had started before the amitotic process had been concluded.

The presence of amitosis in the above tissue is based on the arguments of Hughes (1952) but it is suggested that amitosis is not a normal process of nuclear reproduction. Hence amitosis may occur only in somatic tissues. The present studies as also previous observations in this field indicate that in an organism the germ cells resort only to the mitotic mechanism while amitosis is abundant in the somatic tissue.

Counts of endometaphase chromosome in uninucleate and binucleate cells indicate that in amitosis there seems to be an equal division of nuclear material at least in the lower degrees of polyploidy. But whether amitosis is regular or irregular there seems to be no difficulty to justify its occurrence in somatic tissues as there is evidence to show that aneusomy can be tolerated by the organism in the later stages of development.

Since the cells derived from amitosis continue to function throughout the post embryonic life of the insect it is apparently not a sign of degeneration or weakened vitality. The main difficulty apparently has been to account for the reduplication of chromosomes in amitosis. Based on the observations of previous workers on endopolyploidy and induced somatic reduction, and the observed relationship between endomitosis and amitosis in the tissues of *L. kalmii* it is suggested that amitosis is a kind of somatic reduction where the reduplication of chromosomes is brought about by some form of endopolyploidy.

It is further suggested that amitosis and mitosis are not equal in function. In the former there is both reduplication and reduction. In the latter there is only reduction.

Observations on the cytochemistry of the cell show that the nucleolus and the nuclear membrane are the most important sites for cytoplasmic protein synthesis. It is suggested that both endomitosis (endopolyploidy) and amitosis occur in order to preserve intact the nucleolus and the nuclear membrane which are required for the continued activity of the cell. Endomitosis occurs to increase the nuclear material or nuclear surface required for increased cell activity and amitosis to cope up with the demand for a rapid increase in cell number without disturbing the metabolic activity of the cell.

Experimental work on induced somatic reduction has shown that nucleic acids and phosphates are responsible for the synapsis and division of chromosomes. Since both these substances are formed as the result of metabolic processes, it is suggested that the time of occurrence of amitosis in a cell is decided by the concentration of these substances and this may explain why amitosis takes place in cells of different degrees of polyploidy.

59. Studies on Indian Mymaridae. Part—II.

Miss R. B. KAUR, B. R. SUBBA RAO and E. S. NARAYANAN, New Delhi.

The family Mymaridae comprises of some of the smallest insects, most of them minute and microscopic often measuring only a fraction of a mm. in length, with exceptionally long antennae and narrow wings shaped almost like a paddle, fringed with long hairs. By means of this, these remarkable insects can dive into the water, swim and find out their host eggs. All the members of this family, so

far known, are endo-parasites in the eggs of other insects, particularly Homoptera. They have also been found to parasitise members of Odonata, Lepidoptera, Coleoptera, Neuroptera, Hemiptera and Corrodentia. Some species are known to be parasitic on the eggs of aquatic insects. Some of these parasites have been successfully utilized in the control of crop pests in the Hawaiian islands.

Though a good deal of work has been done on the biology and taxonomy of this group elsewhere, almost very little has been done in this country except for a few species recorded by Mani. Hence an effort has been made to collect systematically these insects from various localities in the Indian Union and study their biology and taxonomic position. In this paper one species of the genus *Polynema* Haliday viz *P. bagicha* sp. nov. and two species of *Maidliella* Soyka viz. *M. orientalis* sp. nov. and *M. incognita* sp. nov. have been described. These species have been collected from the Delhi area. A key to the Indian species of *Maidliella* has been given.

60. A balance for obtaining continuous record of weight change in insects.

H. L. KUNDU, Pilani.

A special balance has been built with which weights of the insects, once they have been put upon the balance, can be determined without touching the insects or the balance. The insects are suspended from a sensitive spring, one end of which is fixed, whereas, at the other end an insect-cage and a transparent linear scale are attached. The changes in the length of the spring can be directly read off from the scale, with the help of a projected beam of light (if in the dark room) or a travelling microscope (if in the laboratory). The spring is suspended within a glass cylinder (of Pyrex) the humidity and the air pressure within which can be controlled. Till now, a sensitivity of the order of 0.10 mg. has been reached. At present, the rate of change of weights of soil-insects under various conditions, are being studied.

61. Determination of the osmotic pressure of the blood of wireworms — *Agriotes* sp. (Elateridae).

H. L. KUNDU, Pilani.

Wireworms are the larvae of Elaterid beetles. Here, the osmotic pressure of the blood of an wireworm, *Agriotes* sp. has been determined by Barger method, in which the evaporation of blood against a standard solution of salt in a capillary is noted after a definite period (incubation period). The results are shown in the following table (in condensed form).

Concentrations. Tubes.		Changes in the length of the drop of blood.			
		Not treated with Repelcote.		Treated with Repelcote.	
		Before incubation.	After incubation.	Before incubation.	After incubation.
0.4% NaCl	...	33	46 (plus)*	21	27 (plus)
0.8%	..	43	40 (minus)*	9	13 (plus)
1.2%	..	33	39 (plus)	18	25 (plus)
1.6%	...	23	23 (zero)*	27	23 (minus)
2.0%	...	71	61 (minus)	43	33 (minus)

* (plus) denotes an increase in length. (minus) denotes a decrease in length. (zero) denotes constancy in length.

One unit of length represents 0.05 mm.

From these data the osmotic pressure of the blood of the larvae of *Agriotes* sp. appears to be, of the order of that of solutions containing 1.2% to 1.4% NaCl which correspond with 9.600 to 11.196 atmospheres.

62. Common Lepidopteran Fauna of Udaipur Including Several Common Pests of Rajasthan together with Brief Notes on their Infestation.

K. S. KUSHWAHA, Udaipur.

About 130 species of moths and butterflies have been collected around Udaipur (ca. 1900 ft. above sea level). Many of these are common pests of agricultural crops and forest trees throughout Rajasthan. 71 of these have been identified up to species and belongs to 57 genera and 21 families. Altogether 62 genera have been identified and belong to 14 families of Heterocera (moths) and 7 families of Rhopalocera (butterflies).

All the families, and under each family all the genera, arranged alphabetically, are the following: (Heterocera) Agaristidae: *Aegocera*; Arctidae: *Amsacta*, *Argina*, *Cretonotus*, *Rhodogastria*, *Utelheisa*; Cymbidae: *Eanas*; Gelechiidae: *Gnorimoschema*, *Platyedra*, *Sitolroga*; Hypsidae: *Aganais*; Lasiocampidae: *Tragama*; Lyonetiidae: *Phyllocnistis*; Noctuidae: *Achara*, *Acontia*, *Agrotis*, *Calesia*, *Chalclope*, *Euxoa*, *Heliothis*, *Laphygma*, *Ophideres*, *Parallelia*, *Prodenia*, *Sesamia*, *Spodoptera*; Plusiidae: *Plusia*; Pyralidae: *Chilotraea*, *Chilo*, *Corcyra*, *Dichocrocis*, *Emmalocera*, *Hymenia*, *Margaronia*, *Pygospila*, *Sciropophaga*, *Sylepta*; Sphingidae: *Acherontia*, *Cephonodes*, *Herse*, *Hippotion*, *Theretra*; Syntomidae: *Syntomis*; Thaumetopocidae: *Eupterote*, *Nisaga*; Yponomeutidae: *Atteva*. (Rhopalocera) Danaidae: *Danaus*; Hesperidae: *Baoris*; Lycaenidae: *Virachola*; Nymphalidae: *Charaxes*, *Emboea*, *Hypolimnas*, *Precis*; Papilionidae: *Papilio*, *Zelides*; Pieridae: *Anaphaeis*, *Colotis*, *Dellias*, *Ixias*, *Pieris*; Satyridae: *Melanitis*.

63. A Survey of Termite Fauna (Insecta: Isoptera) Around Udaipur (Rajasthan).

K. S. KUSHWAHA, Udaipur.

An intensive survey of termite fauna was carried out during 1958-59, around Udaipur (ca. 1900 ft. above sea level) and the neighbouring villages, namely, Bari, Gobardhan Vilas, Dewali, Balicha, Sabina, Titli, Bhila, Phanda and Madri. Specimens were collected from 36 different colonies in the above localities and identified at the Zoological Survey of India, Calcutta. Altogether 4 species belonging to 3 genera and 2 subfamilies of the family Termitidae have been found to occur. These are *Odontotermes* (*Odontotermes*) *obesus* (Rambur), *Odontotermes* (*Odontotermes*) *obesus* *gurdaspurensis* Holmgren, *Odontotermes* (*Odontotermes*) *bangalorensis* Holmgren (syn. *Odontotermes* (*Cyclotermes*) *bengalensis* Holmgren, *Microtermes* *anandi* Holmgren (syn. *Microtermes* *obesi* Holmgren) of the subfamily Macrotermitinae, and *Trinervitermes* *biformis* (Wasmann) of the subfamily Nasutitermitinae.

O. obesus is predominantly represented in all the above localities. *T. biformis* was collected with *O. bangalorensis* in the same mound attacking dead wood of *Euphorbia* sp. at the Makera Forest Range near Bari Hospital (ca. 2150 ft. above sea level), about 7½ miles west of Udaipur. *M. anandi* was similarly collected with *O. obesus* at the Rajasthan College of Agriculture, Udaipur. *M. anandi* was also separately collected from flower pots growing *Chrysanthemum* sp. and *Amaranthus giganticus* at the Agriculture College.

64. Comparative Survey of the Head Capsule of some Hymenopterous Larvae (Braconidae, Encyrtidae, Aphelinidae).

S. MASHHOOD ALAM, Aligarh.

The family Braconidae is represented by *Stenobracon deesae* Cameron while *Melaphycus taxi* Alam, *Euaphycus variolosus* Alam, *Thomsonisca britanica* Alam and *Doliphoceras pseudococci* Alam represent Encyrtidae. The family Aphelinidae is represented by *Aphytis diaspidis* Howard.

The head capsule of *Stenobracon deesae* has comparatively better sclerotic identity based on the presence of epicranial and post-occipital sutures and facial and post-occipital sclerites. Encyrtidae and Aphelinidae lack such sutural and sclerotic differentiations. Antennae are well defined in Braconidae, feebly traceable in Aphelinidae and absent in the Encyrtidae. The shape of mandibles is of some significance for the four genera of Encyrtidae.

In Braconidae the maxillary sclerome as well as various components of the maxillae are well developed. Similarly, the presence of prementum and post-mentum labial palpi bring independent status, as in generalised insects, to the labium. Such structural independence of maxilla and labium is not possible in Encyrtidae and Aphelinidae. All that could be detected is a 'maxillo-labial complex' with mouth as its dorsal and hypostomae as lateral limitations. However, in Aphelinidae a sclerotic semicircular demarcation between 'maxillo-labial complex' and the rest of head wall is traceable and can be taken analogous to labio-stipital sclerome of Braconidae.

It is, thus, evident that Braconidae is primitive and Encyrtidae is better evolved. Aphelinidae has intermediate place. This conclusion is strengthened by larval respiratory and nervous systems and falls in line with the findings of Morphologists on adult's anatomy. The present study also confirms close inter-relationship of the genus *Doliphoceras* Mercet with *Thomsonisca* Ghesquière as suggested earlier by taxonomists (Mercet, 1921, Nikolskaja, 1952, and Alam, 1957).

65. Skeleto-Muscular Mechanism of the Male Genitalia of *Utetheisa Pulchella* Linn. (Arctiidae, Lepidoptera).

R. B. MATHUR and S. MASHHOOD ALAM, Aligarh.

In *Utetheisa pulchella* Linn modified ninth and tenth segments constitute the male genitalia, which is withdrawn within the eighth segment. The ninth tergum (formerly known as tegumen) is a posteriorly tapering sclerite and is emarginate anteriorly. Its lateroventral edges are attached to the dorsal edges of the sclerotic ninth sternum which is 'U' shaped (formerly known as 'vinculum'). It is anteriorly produced to form saccus. Paired parameres articulate on sides of the ninth sternum and are divisible into proximal and distal regions. Mesally the proximal region is fused with the aedeagal apodeme which guides the aedeagus in its movement. Sclerotised aedeagus is supported on basal plate through membranous intervention. It is apically membranous and basally round. Ejaculatory duct enters aedeagus dorsally. Tenth tergum ankylosed with the ninth tergum, pleuron and sternum membranous. Anal tube suspended from tenth tergum ventrally. Important muscles are the protractor of aedeagus, retractor of aedeagus, flexor of paramere, elevator of aedeagal apodeme, and the retractor of the ejaculatory duct.

66. A morphological study of the Salivary glands of the bug *Rhinocoris*.

D. D. MEHRA, Gwalior.

The paper embodied an investigation into the general morphology of the salivary glands of the bug *Rhinocoris marginatus* Fabr. of the family Reduviidae, which comprises the predacious forms.

The paired glands lie in the thorax, extend anteriorly into the head and posteriorly into the abdomen. Contrary to the salivary glands of the other predacious bugs of the family Reduviidae e.g. *Rhodnius prolixus* and *Tritoma infestans*, where the glands show diversion towards degeneration and the accessory glands reduced in size, they are well developed in *Rhinocoris marginatus*. The principal gland which is also well developed is about 10 m.m. in length, richly supplied with trachea and tracheoles. The salivary duct of each side opens separately into the salivary syringe ventrally. Thus the glands are notable on account of their well development.

67. New Coccid inhabiting Encyrtid parasites recorded from Aligarh.

MEEN MOHAN and S. MASHHOOD ALAM, Aligarh.

Arrhenophagous diaspidialis sp. nov. differs from *A. chionaspides* A. in having, the cheek shorter than the transverse diameter of the eye and as much as the width of the frontovertex; antennae with the first segment of the funicle very small, like a ring, much smaller than the second funicle segment; mesoscutum without traces of parapsidal furrows; all the legs are uniformly colored yellowish; body obscure brown.

Ceraptocerus virens sp. nov. can be distinguished from *C. mirabilis* Westw. in the following manner: Frontovertex as wide as the eye, head not punctate round the median ocellus; basal ocellus almost equal to its own diameter from the eye rim and about three times this distance from the occipital margin; hind femur blackish brown rest of the leg whitish; postmarginal vein in the fore wings developed, almost as long as one-third of the marginal vein.

68. Studies on Population Count of Jassids on Wheat and Relative Efficacy of Organo-phosphoric and Chlorinated Hydrocarbon Insecticides.

MOHAMED SULAIMAN VARASI and Y. M. TALE, Nagpur.

Population count of jassids on the wheat and relative efficacy of Organophosphoric and Chlorinated-hydrocarbon insecticides against them was studied at the Agriculture College Farm, Nagpur. Comparing the critical difference with the mean of the jassids population, all the treatments are statistically significant over control but are non-significant between themselves. However, they range in the following order of merit—0.03% Basudin, 0.04% Folidol, 0.03% Endrin, 0.16% DDT 50%, and Nicotinsulphate+Fish Oil Rosin Soap ($\frac{1}{2}$ oz. + 4 ozs. in 4 gallons of water).

The identity of the insect is being determined.

69. Preliminary Studies of the Hydrogen-ion Concentration in the Alimentary Canal of the Tea-mosquito, *Helopeltis theivora* Waterhouse.

D. MUKERJI and RAMKRISHNA GHOSH, Calcutta.

The paper contains the results on Hydrogen-ion concentration of the digestive organs of *Helopeltis theivora*, besides the morphology of such organs and also pH of the leaf extract.

The salivary gland of the bug consists of two principal and two accessory lobes on either side. The mouth parts and hypopharynx are more or less similar to other Heteropteran insects. The alimentary canal consists of the foregut, midgut divisible into three parts and a hindgut. An oesophageal valve is present at the junction of the foregut and the first portion of the midgut, besides usual constrictions at the junctions of the various divisions of the gut. In order to study the enzymatic activities of the different portions of the digestive organs a preliminary data has been collected on the Hydrogen ion concentration, using dyes like Methyl Red and Phenol Red. With the use of Methyl Red three hours after feeding, the foregut reveals a pH of 5.8, 1st midgut 5.8, 2nd midgut 7.5, 3rd midgut 7.4 while hindgut gives a pH of 8.2 with Phenol Red. Using Phenol Red, nine hours after feeding, the pH of foregut is 7.8, first midgut 7.8, 2nd midgut 8.1, 3rd midgut 8.0 and hindgut 8.0. Salivary apparatus with Methyl Red gives a pH of 5.8 while the leaf extract is 4.5.

70. Biometrical Analysis of Sexually Dimorphic Characters in *Helopeltis Theivora* Waterhouse.

D. MUKERJI and RAMKRISHNA GHOSH, Calcutta.

An attempt has been made to find out the range of variation in sexually dimorphic characters of the Tea bug *Helopeltis theivora* Waterhouse. For the purpose of measurement of variable characters in the two sexes, nine specimens of each sex were selected at random. It is found that the following characters are sexually dimorphic at different levels of 't' (statistically significant) :—

1. Length of abdomen, breadth of hindwing and length of rostrum at 1% level.
2. Breadth of forewing at 5% level
3. Length of forewing and length of body at .1% level.

71. Predators and Parasites of Tassar (*Anthereae Paphia*).

N. PANDA, Bangiriposi.

About 40% of the tassar worms that are grown in wild is lost due to its various predators and parasites. Among the predators the chief ones are Reduviid and Pentatomid bugs. Normally the first and second stage worms are killed by such predators by sucking its body juice. A single predator can kill about 10—15 tassar larvae in a day. These are also suspected to be the carrier of bacterial and other virus diseases from diseased to healthy worms. The predators can easily be hand picked by the help of a stick whose one end is pasted with figs gum. Light trapping can control about 60—70% of these predators.

Another interesting ichneumonid endoparasite was found in the pupae of tassar. The female parasite penetrates its ovipositor and lays a single egg just below the epidermal layer of tassar larvae which is just to spin cocoon. No sooner the host larva pupates inside the cocoon the egg of the parasite hatches and its larva then feeds upon the body contents of pupa without damaging the pupal covering. The parasite pupates inside its host pupal covering and the adult parasite emerges by piercing the cocoon wall of its host. The time required for the emergence of adult parasite was 24 days from the date of laying its egg on the body of the host.

The damage of the parasite is two fold, i.e., the host pupa inside the cocoon is killed and thus the cultivators lose their seed cocoons, and the tassar cocoons that are formed become small and flimsy in nature.

72. Life History Study of Tassar.

N. PANDA, Bangiriposi.

The Tassar species of Orissa so far identified was *Anthereae paphia*, L. (Saturniidae). The common variety, popularly known as 'Bogai' tassar is chiefly cultivated in Orissa. This is bivoltine in character. The first generation starts emerging in the middle of June (when the humidity ranges from 70—80% and temperature of about 80—90°F) and completes its life-cycle by middle of August. Moths of first generation emerges in the first week of September and the eggs laid by them completes its second generation by end of November. The cocoons of the second generation undergoes dormancy till next June.

The first generation tassar crop normally grows in cooler places of the interior jungles, and it is never cultivated in plains where the temperature goes up to 160°F. So the only tassar season in plains is from September to December. In this experiment the life-history study of first generation crop was conducted at Govt. Tassar Farm and Research Station, Bangiriposi, Orissa. Worms were reared in June and July '59 right from hatching to completion of spinning cocoons. The temperature during the rearing period was between 102° to 104°F. Humidity could not be recorded and the total rainfall during that period was only 2" and the total days rained was only 10. The following is the life-history of tassar during the months of June and July.

Period required for hatching of eggs	...	6½ days
Period from hatching to 1st moult	.	4 ..
„ „ 1st to 2nd moult		5½ ..
„ „ 2nd to 3rd moult		5 ..
„ „ 3rd to 4th moult	.	5 ..
Duration of 5th age	..	10 ..
Period required for emergence of moth from cocoon		24 ..

The percentage of cocoon yield in respect to hatched larvae was only 5%. The larvae were mostly killed by bacterial disease and one ichneumonid pupal parasite. Thus the summer temperature of plains is not congenial for the growth and development of tassar worms.

73. Hermaphroditism in Tassar Moths.

N. PANDA, Bangiriposi

Functional hermaphroditism is an extremely rare phenomenon in insects and seems to have been evolved only twice i.e., in the scale-insect *Icerya purchasi* and in the Phorid, *Termitostroma*. It is very rare to come across such a phenomenon in lepidoptera. Such an instance has been recorded in the Government Tassar Seed Station, Bangiriposi, Orissa, by the author. The external feature and colour of the said moth is so characteristic that its body along with wings, legs, antennae and even the genital organs are divided equally into two halves as male and female respectively. It was further noted that the said moth had lived for 11 days in a healthy condition. No internal anatomical study could be taken up as this was the only one specimen obtained. Detailed study will be taken up when few such specimen are collected during the tassar cultivating season.

74. A New Species of *Lipoptena indicum* (Diptera Pupipara) from a Deer at Madras.

S. R. RAO, L. S. HIREGAUDAR and V. S. ALWAR, Bombay.

A new species, *Lipoptena indicum* has been described from a deer at Madras. *L. indicum* differs from *L. cervi* in having the thorax with a few setae and the abdomen in female without a plate on tergite 4. The male differs markedly in its genitalia. The genus *Lipoptena* has not so far been represented from India and the record of *L. indicum* is the first of its kinds from this country.

75. Studies on the physiology of digestion in the Alimentary canal and Salivary Glands of *Odontopus nigricornis* Stal (Heteroptera : Pyrrhocoridae).

S. C. RASTOGI, Pilani.

The distribution of enzymes and the hydrogen-ion concentration in different parts of the alimentary canal and salivary glands of *Odontopus nigricornis* Stal is described. In as much as the conditions of the pH, temperature, time, and rate of oxidation under which an enzyme normally functions in the intact living organism, were considered. The 1st, 2nd and 4th midgut regions are weakly acidic, ranging from pH 6.1 to 6.8. The 3rd midgut, the hindgut and the salivary glands are more acidic ranging between pH 5.5 and 6.5. The pH is fairly constant in starved or normal individuals and no difference in the pH with regard to the sex was noticed.

Qualitative tests show that the salivary glands contain amylase and proteinase and the midgut extracts amylase, maltase, invertase, proteinase, lipase and esterase. Proteinase activity from unfed and glucose-fed insects was insignificant. It appears to be secreted only under the influence of feeding. Certain enzymes in the present work seem active under the influence of their specific secretagogues, is suggested.

76. The Anatomy of the Digestive System of *Lygaeus Pandurus* Scop. (Heteroptera : Lygaeidae).

S. C. RASTOGI, Pilani.

A detailed anatomy of the digestive organs of *Lygaeus pandurus* is described. The length of the alimentary canal is in conformity with the phytophagous habits of the insect. The gut is divisible into foregut, midgut and hindgut. The foregut consists of cibarium and pharynx which are undifferentiated in the present case, and the oesophagus proper. Midgut shows four definite regions which are associated with the secretory and absorptive activities. The midgut epithelium consists of columnar cells without any intima. Gastric caeca are absent. An oesophageal valve is present at the junction of oesophagus and the 1st midgut region. The hindgut has two divisions, namely the ileum and the rectum. Four coiled malpighian tubules arise from the ileum. The rectum is thin walled sac with a characteristic intima. A well developed pyloric valve is present, while its absence has been reported in *Oncopeltus fasciatus*, a member of Lygaeidae.

The salivary glands consist of a pair of elongated four-lobed principal and another pair of coiled tubular accessory glands.

77. Physiological factors governing establishment of *Dysdercus koenigii* Fabr. (Pyrrhocoridae) on its host plants. Pt. I. Role of hygrometry in orientation and feeding behaviour.

K. N. SAXENA, Delhi.

In the course of investigations on the physiological principles involved in the establishment of *Dysdercus koenigii* on cotton plant, influence of the various factors on orientation and ingestion of food by the insect has been experimentally determined. Observations on the role of hygrometry are presented in the paper.

This insect shows three types of responses to hygrostimuli: orientation in relation to humidity, proboscis-response to water vapour, and drinking-response. The nature and intensity of these responses depend upon the physiological state of the insect. Starved and desiccated insects prefer to congregate in the region of high relative humidity in comparison to that of low humidity and thus show 'wet reaction'. Also, they extend their proboscis towards the source of water vapour from a distance, if allowed, they begin to drink water.

The starved and desiccated insects, when allowed to ingest water, no more show discrimination amongst the zones of the different relative humidities. Even the proboscis- and drinking-responses are wanting. When the starved, but non-desiccated, insects are fed on cotton seeds they begin to congregate in drier zone, which indicates that 'wet reaction' reverses to 'dry reaction'.

Correlation has been established between the water content of the insects and the nature of their response to hygrostimuli. Fall in the water content of freshly fed insects below a certain level results in a reversal of their 'dry-' to 'wet-reaction'. Temperature and humidity control these responses by influencing rate of their desiccation.

Relative preferences of the insect for feeding on different parts of cotton plant also vary with its water content. Starved and desiccated insects prefer to suck the sap from succulent parts like leaf and green boll. Starved, but non-desiccated, insects feed mostly on the cotton seeds.

Physiological significance of the characteristic responses of *D. koenigii* to hygrostimuli is discussed in the paper.

78. Aphids of Economic Plants of Orissa.

G. C. SENGUPTA and J. N. DAS, Bhubaneswar.

The present authors have for the first time undertaken a systematic survey of the aphids of economic plants in Orissa. The paper deals with the seasonal incidence, nature of damage and distribution of nine species belonging to seven genera which infest cultivated crops, fruit trees and ornamental plants of Orissa. The identified aphids include *Aphis gossypii* Glover, *Myzus persicae* Sulzer, *Aphis craccivora* Koch, *Rhopalosiphum maidis* Fitch, *Rhopalosiphum rufiabdominalis* Sasaki, *Macrosiphonella sanborni* Gillette, *Longunguis sacchari* Zehntner, *Pentalonia nigronervosa* Coquerel and *Toxoptera odinae* Van der Goot. The information furnished is based on extensive surveys and collection of field data during the last two years.

79. Field Tests of Insecticides Against Rice Stem Borer, *Schoenobius incertulas* Wlk. (Pyralidae-Lepidoptera) in 1959.

G. C. SENGUPTA and N. SHI, Bhubaneswar.

The object of the present investigations was to find out the suitable control measures against rice stem borer *Schoenobius incertulas* Wlk. The field trial was

conducted at the State Agricultural Research Station, Bhubaneswar during 1959 on the summer paddy crop locally known as 'dalua' paddy in the randomized block design, there being six replications for each of the five treatments (including control) and the area of each plot being 256 sq. ft. (16'x16'). The insecticides tried were (i) Endrin 0.05%, (ii) Folidol 0.05%, (iii) DDT 0.25% and (iv) Malathion 0.08%. In all, two sprayings of different insecticides were given. The first spraying was given 15 days after transplanting and the interval between the first and second spraying was also 15 days. The statistical analysis of the data showed the percentage of the dead hearts was not significantly different between two treatments that is endrin and folidol. But in other plots treated with DDT and malathion respectively the percentage of dead hearts was significantly higher than in the plots treated with endrin. Also in these treatments the percentage of dead hearts was not significantly lower than in the untreated. As regards percentage of empty panicles endrin and folidol were significantly superior to DDT, malathion and check. The percentage of empty panicles in DDT and malathion treated plots was not significantly lower than in the untreated. According to the yields from the treated plots, endrin was significantly better than folidol. DDT and malathion were the least effective among the treatments. The yield in these two treatments was not significantly higher than in the untreated.

Endrin 0.05% emulsion spray applied two times at 15 days interval gave the best result. Though 0.05% of folidol gave adequate control, was not so satisfactory in effectiveness against this pest as compared with that of endrin.

80. Chemical Control of Sweet Potato Weevil, *Cylas formicarius* Fabr. (Curculionidae-Coleoptera) Attacking Roots and Stems of Sweet Potatoes in the Field.

G. C. SENGUPTA and N. SHI, Bhubaneswar.

The sweet potato weevil, *Cylas formicarius* F. is one of the most injurious insects attacking the sweet potato in different districts of Orissa. Both adult as well as larva feed on stems and roots of the sweet potato. In view of the great economic importance of this pest a replicated field trial in split-plot design was conducted in State Agricultural Research Station, Bhubaneswar to compare the effectiveness of endrin and aldrin with that of DDT applied as soil treatment and soil treatment in combination with cutting dip prior to planting. The potatoes and stems were adequately protected by all the insecticides applied to the soil as spray prior to planting regardless of whether a preplanting vine treatment was used. Aldrin at 5 pounds active ingredient per acre in 182 gallons of water and endrin at 1.46 pounds of active ingredient per acre in 182 gallons of water gave excellent protection from sweet potato weevil. DDT applied at 5 pounds of active ingredient per acre in 182 gallons of water slightly inferior but significantly reduced the weevil infestations. The damage to the potatoes and stems in all the treated plots was significantly less than that of the check plots. The insecticides for controlling the pest in order of toxicity were aldrin, endrin and DDT.

81. The Use of Dassel-Tox for Ox warble-fly (*Hypoderma lineatum*) Control in India.

B. N. SONI and S. C. SRIVASTAVA, Izatnagar.

Dassel-Tox was tried for the control of Ox warble-fly (*Hypoderma lineatum*). This insecticide is a combination of Dieldrin and Derris (Rotenone). Because of the possibility of residues (Roth & Johnson, 1955) the dressing of warble tumours is preferable. Dassel-Tox was found effective to the extent that even immature larvae were killed and absorbed in the body of the host. The treated bulls became

free from warble tumours in 32 days. Full grown larvae squeezed out after 7 days treatment were unable to pupate. This insecticide did not show any irritation to the animal and there seemed to be no detrimental effect on the skin of the host and is non-toxic.

82. Changes in the Hydrogen-ion Concentration of the Digestive Organs of *Leptocorisa acuta* Thunberge.

D. SREENIVASAM and D. N. RAY CHAUDHURI, Calcutta.

The alimentary canal of *L. acuta* consists of a foregut, a midgut divided into four regions and a hindgut divided into two.

The present paper embodies results of preliminary findings in the changes of pH for salivary glands, saliva, foregut, the different regions of the midgut and hindgut; the normal and attacked paddy grains.

The pH of salivary glands and saliva is weakly acidic (6.0) while the insect is feeding and even after a lapse of 24 hours. The pH of foregut is $>5.9 < 6.3$, for first midgut $>5.0 < 6.1$, second midgut $>5.1 < 6.2$, third midgut $>5.0 < 6.0$, fourth midgut $>4.8 < 6.0$, first hindgut $>6.0 < 7.0$ and second hindgut $>6.3 < 7.0$.

A comparison of the pH of the different regions of the gut, while feeding and 6 hours after the feed, reveals that the foregut and midgut are weakly acidic while the hindgut is neutral; after 24 hours the midgut becomes moderately acidic and the foregut and hindgut weakly acidic.

Further studies in this field are in progress.

83. Digestive System of *Leptocorisa acuta* Thunberge.

D. SREENIVASAM, S. N. ROY CHAUDHURY and D. D. MUKERJI, Calcutta.

The digestive system of this species has not been touched by any workers before. The study of such system reveals that it consists of the rostrum, the hypopharynx, the salivary syringe, the salivary glands, the fore-, mid-, and the hindgut. The labium is four-segmented unlike three in some other insects. Not much of difference is noticed in the mouth parts, hypopharynx and the salivary syringe when compared with other Heteropteran insects. The foregut is also as usual while the midgut can be distinguished into four different regions. The junctions of the different regions are marked by valvular arrangements. The hindgut is also differentiated into two regions having a valve at the junction of the two.

From the cellular nature, it seems that the first two regions of the midgut are more for secretion than for absorption while the last two regions are only absorptive. Besides, the fourth midgut is peculiar in having a number of pouch-like structures termed as gastric caeca by other workers. This fact also confirms the absorptive nature of the fourth midgut.

The anterior part of the hindgut receives the malpighian tubules, the posterior part is further subdivided imperfectly into an anterior fusiform structure which may be termed as the rectum and a narrow tubular anal canal. The rectum contains a number of rectal papillae.

84. Tickicidal Value of Certain Insecticides in Animal Husbandry.

S. C. SRIVASTAVA and B. N. SONI, Izatnagar.

Ticks are responsible for transmitting diseases to cattle and domestic animals. They are also responsible for damaging the grain side of the leather (Soni, 1939).

The insecticides, Tic-Kil, Dieldrex and Dieldrin were tried for the control of *Hylomma savignyi*, naturally infesting the bulls. Tic-Kil was supplied to us by Whorli Chemical Works through I.C.A.R. Tic-Kil was sprayed as such whereas Dieldrex and Dieldrin were sprayed in desired concentration in water. It was observed that Tic-Kil was very effective in the control of ticks, and made the bulls tick-free in 36 hours of the treatment with 6-7 days as residual effect on the skin of the bulls, whereas Dieldrex and Dieldrin took 72 hours and 78 hours respectively with 0.05% to make the bulls tick-free with one day as residual effect, and took 49-51 hours and 49-58 hours to make the bulls tick-free respectively with 0.02% concentration with 3-5 days as residual effect on the skin of the bulls. So with higher concentrations of Dieldrex and Dieldrin, no appreciable improvement in the effect of the insecticide was found. A good number of ticks were found dead on the body of the treated bulls in blood-sucking position. While others found crawling on the body of the bulls died very shortly when brought to laboratory for further observations. All the insecticides were non-toxic and has no detrimental effect on the skin of the bulls. Tic-Kil has very strong smell, which is intolerable during the experimental period.

85. Hemoglobin and Erythrocyte Contents of Chicks Receiving Non-lethal Doses of Insecticides.

B. K. SRIVASTAVA, H. C. SAXENA and J. C. SHARMA, Udaipur.

Several of the modern synthetic organic insecticides are showing promise for the control of external parasites of poultry. An attempt has therefore been made to formulate an index for judging the normality of chicks by studying the blood picture which is usually affected by any change in the fluid matrix. Results of such an investigation are reported here.

Twenty-five day-old R.I.R. chicks were randomly distributed into 5 lots of 5 chicks each. They were fed a practical type of basal diet, generally used on the State Poultry Farms in Rajasthan. After a period of 7 days, four insecticides, namely BHC, Dieldrin, DDT, Malathion, at levels of 25, 1.25, 35 and 40 ppm. respectively, were incorporated in the diet which formed the experimental rations. One lot received basal diet to serve as control.

Three observations at 5-day intervals were recorded for the hemoglobin and erythrocyte contents of the chick blood, which was taken from the brachial vein. Standard techniques were used for both the determinations. The results showed a significantly lower hemoglobin and erythrocyte contents of blood on account of feeding each of these insecticides. The hematological values for chicks receiving insecticides showed a faster decrease in the successive observations. Further investigations on the entire blood picture are in progress.

86. On the structure and mechanism of the spiracular regulatory apparatus in *Pantala flavescens* Fabr.

G. T. TONAPI, Poona.

A detailed and illustrated account of the structure and closing mechanism of the spiracles of *Pantala flavescens* Fabr. is given. It is shown, contrary to previous observations, (Krancker, 1884; Hassan, 1944) that the thoracic and abdominal spiracles have different types of closing mechanism. The two thoracic spiracles have an external lid type of closing mechanism while the abdominal spiracles are

provided with an internal lever compression closing device. The shape of the occlusor muscle of the thoracic spiracles is narrow and elongated while that of the abdominal spiracles is broad and fan-shaped.

87. Studies on the aquatic insect fauna of Poona—Part II (Aquatic Coleoptera).

G. T. TONAPI, Poona.

Collection and identification of aquatic insect fauna of certain ecological habitats of Poona and adjoining areas has been undertaken with a view to determine their periodicity and bionomics. The aquatic Coleoptera of this region have not been studied thoroughly in the past and very little is known of their composition, seasonal abundance and variation. This paper being the second part of the report gives results of my spare time collection of aquatic beetles with notes on their habitats. Topographical and meteorological considerations are included in the paper. It is noteworthy that many of these beetles e.g. *Dineutes* (Gyrinidae), *Cybisler* (Dytiscidae) and other species representing Adephaga and *Hydrophilous* (Hydrophilidae) representing Polyphaga show characteristic fluctuations. Attempts are made to correlate these fluctuations with the meteorological conditions. While many of the specimens are still awaiting identification some appear to be new records from this area.

88. The respiratory currents in the tracheal system of *Hierodula coarctata* Westw.

G. T. TONAPI, Poona.

The tracheal method of effecting gaseous exchange is one of the major limiting factors determining the size of insects as a group; since the amount of gas diffusion will be inversely proportional to the length of the trachea. However, an auxiliary mechanism exists, particularly in larger insects, in the respiratory movements performed by the abdominal muscles and these movements ventilate the main tracheae to produce respiratory currents of variable direction. The study of these air currents and factors governing their direction in *Hierodula coarctata* Westw., constitute the subject of the present investigation. The rate and amplitude of the breathing movements are recorded. The activity of the spiracular valves (lids) which is controlled by an internal mechanism is also recorded. Experimental results indicate that normally the thoracic spiracles are strongly inspiratory whereas the abdominal spiracles are chiefly, but not exclusively expiratory and the last pair is very much so. This usual course of air current i.e. inward through the anterior spiracles and outward through the posterior spiracles is subject to some variations depending on, among others, such factor as carbon dioxide concentration. The abdominal spiracles are capable of inspiration and this reversal of air current is limited in its duration. The anterior abdominal spiracles are indifferent in their function in as much as they contribute to the tidal air in whichever direction the air current is passing. The significance of these changes in the direction of air currents is discussed in the paper. Effects of temperature, food, Carbon dioxide and nascent chlorine on the respiratory movements are pointed out.

89. On the respiratory system of *Hierodula coarctata* Westw.

G. T. TONAPI, Poona.

The paper gives a comprehensive and illustrated account of the morphology of the respiratory system of *Hierodula coarctata* Westw. The number, position,

anatomy and closing mechanism of the spiracles are described and an account of the system of tracheae and air sacs is given. Each of the thoracic spiracles is provided with an external peritremal lid and a single occlusor muscle. Abdominal spiracles are all alike with a difference in their size. Each has a discrete peritreme with an internal movable lid to which are attached an occlusor muscle and a dilator muscle. The contraction of the former closes the spiracular opening, the latter acts as its antagonist. The mode of distribution of cephalic tracheae forms a simple pattern in this species. A pair of longitudinal spiracular trunks, dorsal longitudinal trunks, ventral longitudinal trunks are also present. These are interconnected by palisade tracheae, dorsal and ventral commissures. Visceral branches are not strictly segmental in their distribution. In addition, the whole system is interpolated with a developed and segmentally arranged system of air sacs, whose function is to increase the efficiency of tracheal ventilation. The maximum number of air sacs occur in the abdomen, and a comparatively smaller number in the thorax and head.

90. Notes on termites of Delhi.

H. S. VISHNOI, Delhi.

Termites are found abundantly in Delhi and its environs. Pruthi (1939) and Vishnoi (1957) recorded a few species of swarming termites only. During the last few years the author has been able to collect thirteen species: *Kaloterms beesonii* Gardner, alates; *Coptoterms heimi* (Wasmann), alates, workers, soldiers; *Heteroterms* sp. workers, soldiers; *Amiterms belli* (Desneux) workers, soldiers; *Eremoterms paradoxalis* Holmgren, alates; *Microceroterms beesonii* Snyder, workers, soldiers, brachypterous females; *Odontoterms dehraduni* (Snyder) alates; *Odontoterms obesus* (Rambur), alates, workers, soldiers; *Odontoterms* sp. alates; *Microtermes mycophagus* (Desneux), alates, workers, soldiers; *Microtermes obesi* Holmgren, alates, *Microtermes* sp., alates.

Biological notes, and the nature and extent of damages caused by these termites have been briefly mentioned in the paper.

91. The Skeleto-muscular Mechanism of the Male Genitalia of the Melon-fly *Dacus cucurbitae* Coq. (Diptera : Trypetidae).

MD. ZAKA-UR-RAB, Aligarh.

The genital-cum-postgenital portion of the abdomen in *Dacus cucurbitae* Coq., is highly distorted and reflexed under the abdomen. The sixth and seventh terga are membranously represented and are not atrophied, contrary to the observation of Crampton (1942) who thought them to be absent in higher Cyclorrhapha. They are tucked under the fifth tergum to form the aedeagal pouch. The sixth and seventh sternites are closely connected with each other at their left side. The right arm of the seventh sternite is apically connected with the hook-shaped, irregular, eighth sternite. The eighth tergum, regarded previously by Crampton (1942) as sternite, is situated anterior and adjacent to the syn-tergum of ninth and tenth segments, considered by Crampton (1942) as ninth tergum only. The syn-segment at its ventrolateral aspect bears the 'surstyli' which serve as clasping organs during copulation. The true parameres, thought to be suppressed in higher Cyclorrhapha by Snodgrass (1957), are present at the posterior end of the ninth (genital) sternum which is in the form of a ring. They are supplied by muscles from the anterior part of the syn-segment. The tenth sternite is very small and situated in the ventral membranous wall of the syn-segment, close to its posterior

end. The aedeagus is much elongated, coiled and ribbon-like. It arises from the posterior two-thirds of the ninth sternum and at its base bears the cruciform, basal sclerite. It rests in the aedeagal pouch in coiled state.

ARACHNIDA

92. Recent trends in the Taxonomy of the family Phytoseiidae Behrl., 1913, (Predatory Mites) with new records and description of Species.

E. S. NARAYANAN and R. B. KAUR, New Delhi.

Within recent years as a result of the widespread use of organic insecticides, especially chlorinated hydrocarbons, economic entomologists have observed a staggering increase in the population of phytophagous mites that infest agricultural crops and orchard trees. In the main, the reason for this has been the destruction of predatory species in the field that keep the phytophagous species under check, as there is some experimental evidence that the predatory species are more susceptible to these insecticides than the phytophagous ones.

The family Phytoseiidae was first reviewed by Nesbitt (1951) and the basis of specific separation adopted by him was based on that devised by German (1948) which is mainly concerned with the setation of dorsal and ventral surfaces. The various genera comprising this family are separated by the chaetotaxy of the dorsal shield. But here again some confusion has arisen as various workers have taken different aspects of setal characters into consideration and we have yet to decide which one is more rational, reliable and least open to errors of observation and misinterpretation, namely number, arrangement, nature, position or relative length.

In this paper we have taken these characters one by one and discussed their importance in the classification of Phytoseiinae. Emphasis has also been laid on the importance of some anatomical and other minor characters that have not been given the importance by Acarologists that they deserve. Inclusion of these characters in the taxonomy will bring out the morphological differences more clearly between two closely related species.

In addition some new records of species belonging to Phytoseiidae and Cheyletidae together with the description and a key to the world species of *Phytoseius* Ribaga have also been given.

93. Ticks of the Genus *Amblyomma* occurring in India, together with a description of one new Species.

S. R. RAO, L. S. HIREGAUDAR and V. S. ALWAR, Bombay.

All the ticks of the genus *Amblyomma*, occurring in India have been listed and key to all species, including the one described here, has been given for identification. *Amblyomma mudallari*, sp. n., collected from cattle at Madras closely resembles *A. intigrum* but differs from it in size, ornamentation of the scutum in male and in the spur on coxa iv being much longer in male and broadly triangular with posterior angle rounded in female. *A. mudallari* appears to be of rare occurrence and its natural hosts are probably rodents whose tick fauna is not known thoroughly in India.

MOLLUSCA

94. Molluscan Shells washed on the sandy beach at Suratkal, South Kanara.

A. M. PATIL and M. GOPALKRISHNA, Bangalore (S. K.)

South Kanara district has a long coast-line, where very little attempt has been made by any Zoologist so far to survey the marine fauna of the area. A regular record of the fish, crustaceans, plankton, etc. is, however, maintained by the Department of Fisheries. Suratkal is about 8 miles north of Mangalore and has a two-mile long stretch of sandy beach with a few rocky projections jetting into the sea. Rocks are rather rare all along the sandy coast-line of South Kanara District. This beach is strewn with heaps of molluscan shells washed ashore at several places. About 77 different species belonging to 42 families have been recorded in this investigation. *Minolia biangulosa* (A. Ad.), *Arca polula* (Reeve) and *Chione costellifera* (Adam and Reeve) are some of the very abundant forms found on this beach. It also abounds in minute gastropods which are being studied in detail.

FISHES AND FISHERIES

95. Studies on the Cytophysiology of the Pituitary Gland in relation to Reproduction in *Ophicephalus punctatus* (Bloch.). I. The Morphology of the Pituitary Gland.

D. K. BALSORE, Sangor.

The morphology of the normal pituitary gland in *Ophicephalus punctatus* is described by selective staining techniques. The pituitary gland consists of neurohypophysis and adenohypophysis. The neurohypophysis presents loose nerve fibers, connective tissue, the neuroglia cells and Herring's bodies. The brilliantly coloured Gomoripositive fibers and granules are seen in the neurohypophysis and the infundibulum. The nervous lobe enters the adenohypophysis and spreads along its dorsal side. The proadenohypophysis is divided by nerve processes into many parts and represents cytologically chromophobes, acidophils and a few brightly staining basophils. The meso-adenohypophysis shows deeply staining acidophils which are dorsal in position and are distinguished in a wavy fashion. A few basophils are also found among the acidophils. The basophils are ventrally situated and can be recognised into two types by selective staining techniques. The meta-adenohypophysis shows faintly staining basophils and acidophils. The remarkable feature of this region is the presence of finger like processes of the nervous lobe and the rich blood vascular supply.

96. Skull of *Notopterus chitala* (Hamilton).

M. CHANDY and MADHU SUDAN SHARMA, Delhi.

The skull of *Notopterus chitala* is elongated and laterally compressed. On the dorsal surface of the skull are five prominent ridges; two paired and one median, which are characteristic of Notopterid skull. There is a deep curvature on the dorsal surface lending a remarkable appearance to it.

There are two large, oval, lateral cranial fontanelles formed of squamosal, epiotic and exoccipital in the posterior side of the skull. A bundle of brush-like filamentous bones is attached to the posterior edge of the epiotic. The sphenotic fails to enter into the hyomandibula-cranium articulation. In the opercular series, the suboperculum is absent. Eight branchiostegal rays are present; of which the

anteriormost is the smallest. The first two of them lie within the branchiostegal membrane and the third is attached to the lower edge of the ceratohyal while the rest are found along the external edge of the ceratohyal. None of the rays are attached to the epihyal. A pair of well ossified tendon bones are present on the lower surface of the hind end of second basibranchial. The gill-rakers are stout and strong with a number of villiform teeth present on the ventral surface.

Teeth are highly developed. Strong and pointed teeth are borne by maxilla, premaxilla, palatine, entopterygoid, dentary and glossohyal. The presence of such great variety of teeth suggests that *Notopterus chitala* is one of the highly carnivorous fishes found in Indian freshwaters.

Finally, it is interesting to note that there are certain features present in *Notopterus chitala* which are peculiar to primitive Isospondyl namely, the linear extension of teeth in maxilla, well developed circumorbital bones and presence of orbitosphenoid and symplectic.

97. The Food and Feeding habits of *Mystus vittatus* (Bloch).

M. A. HAFEEZ and S. Z. QASIM, Aligarh.

Analysis of the gut contents of *Mystus vittatus* (Bloch) was made both qualitatively and quantitatively. Qualitative analysis revealed that the fish has an unrestricted choice of food. It feeds on a variety of animals and plants. The main food items are crustaceans, insects and their larvae, aquatic arachnids, algae and remains of higher aquatic plants. Crustaceans and insect larvae form the chief food of the fish as they occur abundantly and persistently throughout the period of observation. Their highest percentage was obtained in the month of July. Fish scales, insect eggs, sand and mud were also seen in the guts. These organisms appear in restricted numbers only in some months of the year.

Quantitative analysis showed that there is a seasonal variation in the rate of feeding. The intensity of feeding is lowest in the winter months and highest during the monsoons.

The presence of a variety of food organisms suggests that *Mystus vittatus* feeds freely at all depths.

98. Osteology of *Wallago attu* Bloch and Schneider, Part II. Osteology of the vertebral column and associated ribs, weberian ossicles and median fins.

MRS. N. I. JOSEPH, Trivandrum.

The paper gives a detailed account of the vertebral column and associated ribs in *Wallago attu*. The vertebral column consists of 73—75 vertebrae. The centra are typically amphicoelous. The first vertebra is fused with the basioccipital. The second vertebra is opisthocoelous. The complex centrum is large, amphicoelous and formed of the third to the fifth vertebrae; the spinous processes are confluent. The opisthocoelous second centrum, devoid of transverse processes, seems to function as an axis in relation to the first centrum which is fixed. This is the first record of an opisthocoelous centrum in Siluroidei and the author suggests that it is an adaptation for a mobile neck region which can at the same time withstand stresses and shocks.

The weberian ossicles are the scaphium, intercalarium and tripus. The dorsal fin consists of four radials and five fin rays. The radials are fused together distally for about 2/3 their length to form a thin laterally compressed bone. The anal fin is very long and consists of 79—93 fin rays seated on 79—93 radials and supported by 51—53 haemal spines. The axonost is fused to the baseost; the distal

segment of the radial is well ossified. The last three caudal vertebrae support the caudal fin which is composed of a single epural, single dorsal free radial, a well marked urostyle, eight hypurals and usually 24 fin rays. The epichordal lobe of the fin has only four fin rays.

There is much similarity in the nature of the transverse processes of the fourth vertebra, the articulation of the skull to the vertebral column, the form and position of the weberian ossicles and median fins in *Plotosus* and *W. attu*. This seems to indicate a close relationship between the families Plotosidae and Siluridae.

99. The development of the osteocranium in *Nerophis* (Lophobranchii-Teleostei).

K. M. KADAM, Bangalore.

Seven stages in the development of the osteocranium of *Nerophis* have been studied. The doubtful homologies of certain bones, like the metapterygoid, the suborbital chain of bones and the posttemporal have been discussed. It is noticed that the metapterygoids, the nasals, the parietals and the orbitosphenoids are absent. The suborbital series of bones of other teleosts is represented by a suborbital and a preorbital. The posttemporal is peculiar in that it forms a part of the posterolateral wall of the auditory capsule. The bony labyrinth of the auditory capsule exhibits a single bony septum which is present in the pterotic bone,—a feature hitherto unrecorded in the syngnathids.

Only a few bones, viz., the prootic, the pterotic, the epiotic and the palatine are cartilage bones while the rest of the bones of the skull are either membrane or chondromembranal bones.

100. Effects of metabolic inhibitors on the oxygen consumption of goldfish acclimated to cold and warm temperatures.

MADHU S. KANUNGO, Cuttack.

Goldfish, *Carassius auratus*, were acclimated at 10° and 30°C. The oxygen consumption (Q_{O_2}) of the liver homogenate of cold-acclimated fish was higher than that of the warm-acclimated fish. The inhibitions of oxygen consumption by amytal and antimycin, specific inhibitors of the cytochrome system for the electron transport, were significantly higher in the cold-acclimated fish. However, carbon monoxide did not show any difference in the Q_{O_2} of both groups of fish. It has been concluded that a full complement of the cytochrome system operates in the liver of goldfish and that the energy trapping system coupled to cytochrome system is impaired causing lesser activity in the cold-acclimated fish.

101. A note on the buccal cavity and alimentary canal of *Barbus tor* in relation to its feeding habits.

O. P. KHANDELWALA, Naini Tal.

Barbus tor which abounds in the lakes of Naini Tal is a carnivorous fish. It has been observed to feed voraciously upon the fries and fingerlings of the mirror carps which has been recently introduced in these waters. This paper deals with the preliminary account of the structure of the mouth and certain other peculiarities of the buccal cavity and the alimentary canal which are co-related with the feeding habits of this fish. The mouth is not much protrusible, but the gap of the mouth is fairly wide on account of the presence of highly extensible rostral

ligament. The pharynx is provided with an elaborate masticatory arrangement which grinds the hard food before it passes on to the oesophagus. The intestine can be differentiated into four regions on the basis of its mucous folds.

102. Studies on the accessory glands and testes of some Siluroid fishes, Part I. *Heteropneustes fossilis* (Bloch.).

P. V. NAIR, Agartala.

Accessory glands ('seminal vesicles' which have been regarded by some authors as homologous with them) have been reported from fishes belonging to mainly the Gobidae and the Blennidae. A study of the existing literature on the subject, however, shows that their existence is by no means common in fishes; but their presence in the siluroids has been generally overlooked. This paper, therefore, is the first in a series in which the results of the investigations carried out at Banaras during the years 1951-1953 on the structure and possible function of the accessory glands and the testes of various siluroid fishes are being given.

A full historical resumé of the reports of similar structures made by earlier authors is incorporated in this paper. The paper mainly deals with the morphological and histological aspects of the testes, their accessory glands, the spermatic ducts, the conduits of the accessory glands and the urinogenital papilla of *Heteropneustes fossilis*. An attempt has also been made to give here a full account of the macroscopic and microscopic seasonal changes occurring in its testes and the accessory glands as observed at Banaras. This paper includes a discussion on the seasonal changes, the nature of the secretion and its probable function.

103. Studies on the accessory glands and testes of some Siluroid Fishes. Part II. *Clarias batrachus* (Bleeker).

P. V. NAIR, Agartala.

In continuation of the study undertaken on the male reproductive system of Siluroids, an attempt has been made to present here the results obtained on a detailed morphological and histological study of the different parts of the male reproductive system of *Clarias batrachus*.

Unlike in the case of *Heteropneustes fossilis*, the testis of *Clarias batrachus* is, as revealed by the histology of its different regions, divisible into three regions : (i) a purely seminiferous anterior region extending to nearly two-thirds the length of the testis; (ii) a purely glandular posterior region (corresponding to the accessory glands in *Heteropneustes fossilis*) forming nearly one-third of the length of the testis; and (iii) a very short, intermediate transitional zone, where the transition of the seminiferous tubules to the glandular follicles is evident. Further, the macroscopic and microscopic seasonal changes occurring in the glandular and the seminiferous regions of the testis, the mode of secretion and its nature, its probable usefulness to the fish and the arguments against consideration of these glandular structures as being homologous with the 'seminal vesicles' or the 'prostates' of higher vertebrates, have been discussed.

104. Studies on the accessory glands and testes of some Siluroid fishes. Part III. *Rita rita* (Hamilton).

P. V. NAIR, Agartala.

This paper gives a detailed report of the morphology and histology of the male reproductive organs of *Rita rita*, as well as the macroscopic and microscopic seasonal changes affecting them.

The paper reveals the novel and bizzare appearance of the testes of this fish in as much as the posterior two-thirds of its length consists of bunches of translucent *tubular adventitia* attached to the spermatid duct and opening into it. Sections of the testis taken at different levels throughout its length has shown three histologically different regions: (i) an anterior, adventitia-free, spermatogenic region extending to slightly less than one-third the length of the testis; (ii) a posterior glandular region bearing the tubular adventitia and extending to nearly two-thirds the length of the testis; and (iii) a short, intermediate transitional zone. The single tubular lumen of the tubular adventitia is generally lined by a single layer of secretory epithelium, which though columnar in the beginning, suffers in height as more and more secretion accumulates in their lumen. The adventitia are covered by very thick connective tissue coat. This connective tissue coat and the lumen of the tubular adventitia show seasonal cyclical changes, in their thickness and diameter respectively. In many of the tubular adventitia, their tip may show a small knob which lodges inside a seminiferous tubule or two. The seminiferous tubules, and, the spermatid and the spermiduct ducts have an unusually thick connective tissue coat. The urinogenital papilla of this species is peculiar in showing a large number of blood sinuses in its substance which probably help in the erection of the papilla. The mode of secretion, the method of replacement of the damaged secretory cells, the nature and probable usefulness of the secretion have been reported and discussed.

105. Studies on the accessory glands and testes of some Siluroid fishes. Part IV. *Mystus vittatus* (Bloch.).

P. V. NAIR, Agartala.

This paper presents the observations of a detailed study of the morphology, histology and the seasonal changes (macroscopic and microscopic) of the male reproductive organs of *Mystus vittatus*. Although the testis of this fish shows regional histological differentiation into an anterior spermatogenic, posterior glandular and an intermediate transitional zones as in *Rita rita*, it exhibits many structural differences from the condition obtained in *Rita rita*. As for example, the tubular adventitia of the glandular region of *Mystus vittatus* are not only fewer in number but are also made up of a number of glandular follicles in the place of a single tubular lumen of the former species. Each tubular adventitium of *M. vittatus* looks very much like a miniature accessory gland of *Heteropneustes fossilis* without its conduits. The seminiferous region of the testis and its duct are very much similar to that of *H. fossilis*. As in the case of other siluroids described in the previous parts, the mode of secretion, the replacement of the collapsed follicles, the relationship of the spermatid and the spermiduct ducts, their special features, the morphology and histology of the urinogenital papilla, the nature and probable usefulness of the secretion of the accessory glands are reported and discussed here.

106. Studies on the accessory glands and testes of some Siluroid fishes. Part V. A comparative study of the male reproductive systems of *Mystus aor* (Ham.); *Wallago attu* (Bloch.) and *Pangasius pangasius* (Ham.).

P. V. NAIR, Agartala.

The need to understand the extent and magnitude to which the peculiarities observed in the male reproductive systems, described in the previous parts, are present in other siluroids prompted the author to study the morphology and histology of the male reproductive organs of *Mystus aor*, *Wallago attu* and *Pangasius pangasius*. The results are recorded in this paper.

As a result of these studies it has been shown that although a separate glandular region or a separate accessory gland did not exist in these species, *Wallago attu* shows a primitive development of the glandular tissue in connection with its testis, because the epithelium of its seminiferous tubules are partly spermatogenetic and partly secretory. *Mystus aor* which shows no trace of any accessory gland has its whole of the testis spermatogenetic except its short caudal portion which is sterile, being composed of tubules similar to that reported by Satyanesan (1959) in *Mystus seenghala*. In *Pangasius pangasius*, the extensively developed tubular adventitia throughout the length of the testis are composed of seminiferous tubules most of which soon after active spermatogenesis are seen to be made up of a single layer of cuboidal epithelium. The conditions obtained in these fishes have been compared with those reported earlier in other siluroids. Further investigations on similar lines are in progress.

107. On the sex-ratio determination and the size distribution in *Barbus stigma* (Cuv. & Val.).

BISWANATH MITRA and S. K. BRAHMA, Calcutta.

The present communication embodies observation on the sex-ratio determination and the size distribution in *Barbus stigma* (Cuv. and Val). The investigation is based on the collections during the period, January to December, a few years back. The important conclusions drawn from the observations are as follows :

- (1) There is preponderance of females over males except on one occasion.
- (2) Sex-ratio analysis of samples taken for twelve months, shows an overall 1 : 1.73 male to female ratio.
- (3) The variation of sex-ratios in different months, tested by Chi-square, indicates no significant departure from 1:1 except on one occasion where the sex-ratio differed significantly from an even representation.
- (4) The males are significantly smaller in size than females.
- (5) The males are predominant in smaller size groups but females in larger.
- (6) The length groups above 11 cm. are only represented by females.

108. Preliminary studies on the collection of Spawn, the nature of the trade and the condition of water of the River Hooghly at Chandernagore.

BISWANATH MITRA, Chandernagore.

The present paper relates to the knowledge of the spawn collection, the nature of the trade and the condition of the water of the river Hooghly in the area of Chandernagore situated 22 miles away from Howrah station. This centre is on the river Hooghly and is well known for the collection of spawn. A description of the various aspects of the trade is given and the difficulties felt by the catchers are also pointed out. The condition of water (with special references to pH, temperature and turbidity) is described on the basis of the data collected during the season of collection and the study of the different conditions of the river-water during other seasons is being continued. The variations in pH and temperature recorded so far were 6.1 to 7.0 and 28.8°C to 34°C respectively.

109. Studies on the maturation and spawning of the Indian Whiting (*Sillago sihama*, Forskal) from Karwar Waters.

V. C. PALEKAR and D. V. BAL, Bombay.

A detailed study of the ovary and its maturation in *Sillago sihama* from Karwar, an important fishing centre along the West coast of India, was made

during the year 1950-51. The nature of spawning of the fish has been determined on the basis of ova-diameter measurements, on the lines indicated by Francis Clark (1939) in her studies on the maturity of California Sardine. The data primarily includes examination of over 500 specimens collected from the Kali River Estuary Karwar, where the fish is found in abundance during the period—June to October—which marks the breeding season of the fish. The maturation cycle has been brought out through monthly size progression of ova as indicated by ova-diameter measurements. The mature ova of *S. sihama* measured from 0.57-0.80 mm. in diameter. The spawning has been found to take place over a short duration and only once during the season. The size of the fish at first maturity has been approximately fixed at 240 mm. in total length, whereas the largest female attained a length of 354 mm. The number of mature eggs liberated in a single spawning has been found to vary over a wide range of 16682 to 166130 in sizes of fish ranging between 184 mm. to 340 mm. in total length. The relation between the length of fish and the number of ova produced has been indicated as—

$$F = (0.00001817) (L)^{4.31}$$

where F—Total number of mature ova

and L—Total length of the fish

110. The Biology of *Ophiocephalus punctatus* Bloch.

A. QAYYUM and S. Z. QASIM, Aligarh.

Studies on the biology of *Ophiocephalus punctatus* Bloch include the following aspects.

1. Food and feeding habits. 2. Breeding. 3. Growth.

The food of the fish, as revealed by an analysis of its gut contents, consists of fishes, insects and shrimps. These organisms are mostly consumed by larger fishes. Smaller fishes eat mainly cyclops, daphnids and insect larvae. The food of the larval fish includes algae, protozoans and cyclops.

Observations on the maturity of gonads throughout the year indicate that both sexes mature and begin to spawn when they are just one year old. They measure approximately 13 cms. in length. Breeding season lasts from June to September. In the population, both the sexes occur in almost equal numbers. Size frequency distribution of the maturing eggs in a ripe ovary shows two groups of eggs. These groups indicate that the fish spawns twice during the breeding season. Fecundity of the fish varies from 2464 to 7150. There is a parental care in this species. Both sexes have been seen to guard the newly hatched larvae.

No evidence of age and growth was obtained from the scales and otoliths. Therefore, the study of growth rate was mainly confined to the size frequency distribution. Distinct modes corresponding to first, second and third year classes can easily be distinguished from the size frequency histograms. Growth rate is relatively faster in the first year but in the older age groups it slows down causing an overlap in the size frequency histograms.

111. The toxic action of saponin extracted from *Dassia longifolia* (Linn.) (Mahua) oil cake on freshwater fishes.

S. Z. QASIM and I. P. VARSHNEY, Aligarh.

The saponins are plant substances mostly containing sugars. They are readily soluble in water and have a marked tendency to form foams. They thus derive their name from *Sapo* meaning soap. Very little is known about the saponins of Indian plants and practically no information is available on their properties.

The oil cake of *Bassia longifolia* (Mahua) yields about 22% pure saponin. This saponin has been found to be a virulent respiratory poison to all common forms tried so far. Small concentrations of up to .003% have been found to be lethal even to the hardiest species. The action of saponin is rapid and fishes die very quickly.

The toxicity of *Bassia longifolia* oil cake has also been investigated. By using a range of concentrations it has been shown that .025% solution is lethal to almost all common forms. Their survival time decreases by using higher concentrations.

The toxicity of saponin seems specific to fishes. Planktonic Crustacea e.g. Cyclops and Daphnids remain unaffected in concentrations which are lethal to fishes. Moderate quantities of saponin in solution lose their toxicity within 15-20 days and become totally innocuous to all fishes.

112. Duration of breeding and frequency of spawning in some freshwater fishes.

S. Z. QASIM, A. QAYYUM and A. N. P. U. KUTTY, Aligarh.

On the basis of oocyte diameter frequency distribution, the ovaries of freshwater fishes can be roughly classified into three main categories (1) those which have a well marked single group of oocytes e.g. *Heteropneustes fossilis* (Bloch), *Mystus vittatus* (Bloch) and *Mystus cavasius* (Ham.), (2) those which have more than one clearly defined groups e.g. *Ophicephalus punctatus* (Bloch), (3) those which have oocytes of all sizes ranging from the smallest to the largest with no well marked batches e.g. *Barbus tor putitora* (Ham.). On the basis of these conditions the duration of the breeding seasons and the differences in the spawning habits in various species could be determined. Fishes with one group of oocytes presumably spawn once a year—their breeding season being short and occurring during a definite period of the year. Clearly defined two or more stocks lead to a prolonged breeding season with an interrupted cycle of maturation and depletion of gonads. Oocytes of all size with no well marked batches on the other hand, probably reveal a non-seasonal breeding. In such species the production and withdrawal of eggs from the ovary seems a continuous process and the cycle can occur at any time of the year if the conditions for feeding and spawning are favourable.

It is surprising to find such differences in the spawning behaviour among the freshwater fishes of the tropics and so far no clue has been discovered towards any general principle which could explain these differences in terms of adaptive advantage to the species.

113. The Measurement of Carbon Dioxide Produced by Air Breathing Fishes and Evidence of the Respiratory Function of the Accessory Respiratory Organs.

S. Z. QASIM, A. QAYYUM and R. K. GARG, Aligarh.

In an apparatus designed to measure the amount of carbon dioxide produced by the air breathing fishes, several series of experiments were carried out. Fishes were kept in an empty air tight flask and the air contained in the flask was removed by means of a vacuum pump. Carbon dioxide free air was then passed in the flask and the fishes were allowed to respire in this medium over a definite length of time. The total amount of carbon dioxide produced by respiration was finally evacuated from the flask through U tubes containing CaCl_2 and KOH. The weight of the latter being carefully determined previously. The increase in weight in the KOH tube gave an index of the CO_2 produced during respiration.

The respiratory process of the following three species was investigated: (1) *Ophicephalus punctatus* (Bloch). (2) *Clarias batrachus* (L.) (3) *Heteropneustes fossilis* (Bloch). *O. Punctatus* which possesses paired pharyngeal diverticula as

organs of breathing air, produces the least quantity of CO_2 (mean wt. of CO_2 produced per unit wt. of fish in 6 hrs. being .001005 gms.). In *C. batrachus* and *H. fossilis* the production of CO_2 is relatively higher. Both these species possess opercular lungs. The differences in the CO_2 produced between the three species fall in close agreement with the structural complexities of their accessory respiratory organs.

The rate of production of CO_2 in all the three species decreases in relation to time. After 24 hours most of the fishes become moribund but soon recover when kept in aerated water.

114. On the occurrence of Adenoma in the Gill Regions of a Trout *Salmo ferio*.

H. L. SARKAR, Delhi and R. DUTTA CHAUDHURI, Calcutta.

This paper deals with the morpho-histology of a tumourous outgrowth, the adenoma in a trout, *Salmo ferio*, collected from Nainital lake. Two unequal tumours have been situated ventrally on both the sides of the isthmus near the branchiostegal membranes. The outgrowths, one on each side, enter the gill chamber and penetrate the gill filaments of the last two gills. The tumours have been observed as sessile, polypoid mass with smooth and intact mucosal surface. Gray, homogeneous small cystic areas are seen internally after cutting the tumour into two halves. The tumour is formed of multiple acini which are narrowed tortuous channels lined by cuboidal cells arranged in a single layer on a very delicate stroma. The nuclei of the cells are round or oval, hyperchromatic and centrally placed; mitotic figures are absent. The tumour under discussion is supposed to have originated from the cells in the mucous membrane of the gills having embryonic potentialities.

115. On the absence of ventral and anal fins in two Carps *Cirrhina mrigala* (Ham.) and *Catla catla* (Ham.).

H. L. SARKAR and N. K. KAUSHIK, Delhi.

This communication records the absence of the pelvic fins in a *Cirrhina mrigala* and the anal fin in a *Catla catla*, collected from the market and from a local pond respectively. After the dissection it was observed that the pelvic girdle was also completely absent in *Cirrhina mrigala* while in *Catla catla* only a proximal piece of radial bone was located. The probable causes of the absence of the fins and bony elements have been discussed.

116. Structure and interrelationship of air bladder, Weberian Ossicles and internal ear in *Mystus* (*Osteobagrus*) *Seenghala* (Sykes).

H. L. SARKAR and R. P. MATHUR, Delhi.

The present communication embodies a detailed account of the structure and interrelationship of air bladder, weberian ossicles and internal ear in one of the commercially important silurid fishes, *Mystus* (*Osteobagrus*) *seenghala*.

The air bladder is an elongated, heart shaped structure with two deep constrictions in the middle and with two sac like elastic swellings at the anterior extremity. Its internal cavity is divided by a "T" shaped septum into three compartments, one anterior transverse, and two lateral longitudinal. The weberian ossicles are made up of four bony elements,—the tripus, scaphium, intercalarium and claustrum. The first three bones are interconnected while the last one is free. One end of

the posterior process of the tripus is attached to the anterior chamber of the air bladder while the other end rests on the lateral wall of the compound vertebrae. The free end of the horizontal limb of the scaphium is closely applied to the lateral atrial aperture of the sinus imparis on each side. The claustrum lies closely applied to the ascending limb of the scaphium. The internal ear consists of utriculus, semicircular canals, sacculus and lagena. The utriculus, sacculus and lagena contain the usual otoliths like lapillus, sagitta and asteriscus respectively.

These organs have been found to be interrelated in conveying the vibrations from the air bladder to the internal ear and the mechanism has been described. The movement of the thin antero-lateral elastic walls of the air bladder is passed to the tripus which causes the movement of the horizontal limb of the scaphium against the lateral atrial aperture in an inward and outward direction. This acts on the perilymph and is passed on to the endolymph of the sinus imparis. The endolymph stimulates the sensory part of the ear and thus brings the stimulus to the internal ear.

117. Fish Fauna of Bhopal Upper Lake.

DEEN DAYAL SONI, Bhopal.

The fishes were collected from the Bhopal upper lake in the month of Jan., 1959. The upper lake is separated from the lower lake by Kamla Park Road and is fed by a tributary of *Betwa River*. The lake is fairly large, oligotrophic type with large amount of cold greenish water. In this season the average depth of the banks is 5-2. The findings of *Ophiocephalus* and *Bclone canila* were also observed in abundance towards the banks of the east-west side in the muddy areas. Fingerlings of the *Rasbora*, *Labeo*, *Barbus* were found in abundance in the month of July. The number of genera and species belonging to different families is as follows :

Family Cyprinidae 12 genera 19 species, Family Siluridae 7 genera 7 species, Family Clupeidae 1 genus 1 species, Family Notopteridae 1 genus 1 species, Family Scombreidae 1 genus 4 species, Family Ophiocephalidae 1 genus 4 species, Family Nandidae 2 genera 2 species, Family Rhynchobdellidae 1 genus 2 species, Family Percidae 1 genus 1 species, Family Gobiidae 1 genus and 1 species, Family Mugilidae 1 genus 1 species.

118. Morphology of the skull of *Barbus Tetrapagus* (Day).

DEEN DAYAL SONI and JOSEPH FENN, Bhopal.

In *Barbus tetrapagus* the upper jaw of the skull is formed by the premaxillaries and the jaws are toothless. The ethmoid region consists of nasals, ectoethmoids and lacrymals, and a dorsal median bone like rostrum, mesethmoid and ventrally placed vomer. The rostral spine is connected anteriorly and posteriorly with the premaxilla and mesethmoid. The orbito-temporal region consists of dorsal frontals, and alisphenoid bones on either side. The orbit is completely surrounded by the orbital bones. The post-temporal bone connects the skull with the pectoral girdle. The occipital region consists of four occipital bones encircling the foramen magnum.

The splanchnocranium consists of five pairs of visceral arches, apart from mandibular and hyoid arches, and three pairs of branchiostegal rays. The first three pairs of visceral arches are complete, the fourth pair is represented by two dorsal and one ventral elements. The fifth branchial arch consists of only curved, stout, ceratobranchials.

119. The study on the Afferent Blood Vessels in *Callichorus bimaculatus*.

DEEN DAYAAL SONI and RAJ KUMAR GAUR, Bhopal.

In *Callichorus bimaculatus* (Ham. Buch) a small median blood vessel arises from the ventral aorta, which immediately gives off third and fourth afferent blood vessels of both sides. These blood vessels directly enter the third and fourth gill arch. Further the ventral aorta gives off a medium ventral blood vessel which connects the first and second afferent blood vessels in the mid ventral line. The first and second afferent blood vessels arise from the anterior region of the ventral aorta and directly enter the first and second gill arch.

120. Pituitary Gland in Triploid Fish.

H. SWARUP, Saugor.

The gonad differentiation in the experimentally produced triploid *Gasterosteus aculeatus* (L.) was very much delayed and the adults showed their gonads to be almost sterile. The pituitary glands of these fishes are studied and a comparison made with those of normal fish. It is shown that the size of the individual cells in the triploids is larger though the number of cells per square area is smaller as compared with the size and number of similar cells in the normal fish. The neurohypophysis extends into the meta-adenohypophysis by a large trunk and its nerve processes surround the group of cells of the meso-adenohypophysis dorsally. The pro-adenohypophysis cannot be distinguished into chromophilic and chromophobic regions as is the case in the normal pituitary. The meso-adenohypophysis occupies a central position and consists of oval acidophils, a few typical basophils and chromophobes. The cells of this region are larger than those of other parts. The basophilic and acidophilic granulation can be observed in the same cells of the meso-adenohypophysis.

121. Collection of Major Carps Spawn, Fry and Fingerlings in Gwalior Division.

R. P. TULI and R. K. MEHRA, Gwalior.

Gwalior division which is blessed with the Gangetic water-shed possesses all the valuable carps i.e. Rohu (*Labco rohita*), Narain (*Cirrhina mrigala*), Bawas (*Catla catla*), Calbasu (*Labco calbasu*). These fishes breed in natural spawning grounds and reservoirs of the division. The paper deals with the variable conditions in which spawn, fry and fingerlings are available and their methods of collection. Eggs 4 to 5 mm. in size are collected from the breeding ground by 4 ft x 3 ft. rectangular net made from 2 mm. round meshed cloth and by 12 ft. long shooting nets. Hatching is done in double walled happas. Fry and fingerlings 25 to 150 mm. in size are collected from reservoirs by 50 ft. x 10 ft. rectangular nets made from 2 mm. round meshed cloth from the marginal areas. Fingerlings are also collected below the pick up weir constructed across rivulets where they congregate when water over-flows. Here collection is done by cast nets of $\frac{1}{4}$ " to $\frac{1}{2}$ " mesh (diagonal) and small bag nets of $\frac{1}{4}$ " mesh (diagonal). It has been concluded that pure spawn of major carps is found if collection is made from the breeding ground itself. 2. Extra aeration or flow of water is not necessary for successful hatching if eggs are placed in a single layer. 3. Reservoirs where breeding of carps takes place, offer a great scope for collection of fry and fingerlings from there itself.

122. Bacteria associated with Prawns preserved in ice.

N. K. VELANKAR, Mandapam.

A number of bacterial spp. isolated from the muscle of prawns preserved in ice are described. Prawns landed at Mandapam (Palk Bay) and at Cochin on the West Coast, belonging to different spp. were used in these studies. The bacteria are tentatively divided into six groups. Gram negative asporogenous, achromic, coccoid or coccobacillary, non-motile organisms were predominant. Achromic, Gram negative, nonsporin usually motile, rods with polar flagellation were next in abundance. Gram negative large spherical organisms, inert in biochemical reactions, were present to a considerable extent in the Cochin prawns; these do not resemble any described spp. in Bergey's Manual. The flora also included *Flavobacterium*, *Micrococcus* and a number of other miscellaneous types. None of the bacteria produced gas from sugars though some produced acid from dextrose and a few from lactose also. A few produced hydrogen sulphide and indol. Fermentative ability was more common in the Mandapam strains.

The problems encountered in the identification of bacteria from marine sources are discussed and the need for maintaining type cultures of marine bacteria in order to facilitate taxonomic studies which are necessary for an adequate classification of these bacteria, is stressed.

123. The use of M. & B. Compound Alamask C.P.M-X to prevent Malodour in the fish processing industry.

A. G. VASAVAN, Calicut.

Offensive odour associated with the fish processing industry is a source of nuisance both to those associated with the industry and the general public. The odour can be removed by (1) Reodouration or perfuming, (2) Counter-action, (3) Cleanliness and (4) Washing.

The use of M & B Compound Alamask C.P.M.-X was tried for counter-acting and reodouration of the malodour present in fish processing plants and places where fresh or dried fish is handled in bulk. A 4% solution water miscible Alamask C.P.M-X was sprayed in control spots in Fish Curing Yard, Prawn Processing centre, Cold Storages, Fish Meal Plant and on trial consignments of partly spoiled fish and salted fish. The resultant odour was observed by a selected group of six people and their opinion recorded. The offensive odour of fish is found to be almost completely masked by pleasant smell of the Alamask compound and the fragrance of the compound prevail for 3 to 4 hours. The use of this compound for fighting the 'smell nuisance' in the railways is suggested. Further experiments using different ranges of this compound are in progress.

124. Experiments of preservation of oil Sardines (*Sardinella longiceps*) by quick freezing.

A. G. VASAVAN, P. GANGADHARAN and V. PADMANABHAN, Calicut.

The preservation of oil sardines (*Sardinella longiceps*) is a difficult problem due to the high percentage of fat which deteriorate in frozen, iced or cured storage. In our experiments oil sardine samples of fairly high fat content (50% on M.F.B.) were packed in waxed cartons and quickly frozen at -40°F in (1) Water and (2) A solution of 0.05% ascorbic acid. They were stored at 0°F and periodically glazed in water and ascorbic acid solution (0.05%). Monthly observations were conducted and samples tested for total viable count on sea water

agar and analysed for moisture, fat, acid value and peroxide value. The results indicate that samples frozen in water can remain in good condition for four months and those frozen in ascorbic acid solution for six months. Since this is a sufficiently long storage life for a fish of highly perishable nature like oil sardines, there is scope for large scale preservation of this fish by quick freezing.

125. Studies on the Manufacture and Preservation of Prawn Pickle.

A. G. VASAVAN, E. SAROJINI DEVI and SATHYAVATHI TIMOTHY,
Calicut.

Chemical and bacteriological changes occurring during the storage of prawn pickle made according to a recipe adopted in Fisheries Technological Station is studied.

The pickle remained in good condition even after 4 months and its nutritive value is practically unaffected. The flavour of the pickle remained the same and there was no growth of Halotolerant organisms. The content of acid tolerant organisms was also very low. The pH which showed a slight initial rise remained steady afterwards. The net acidity was also well above the spoilage point.

126. Studies on the Seasonal Variation in the Fat Content of Indian Oil Sardines (*Sardinella Longiceps*).

A. G. VASAVAN and P. GANGADHARAN, Calicut.

The seasonal variation in the fat content of Indian Oil Sardines (*Sardinella longiceps*) was investigated over a two year period.

A peak was observed in October-December and this can be attributed to the intense feeding activity of the fish due to abundant plankton in the post-monsoon period. Early in the season the fat content is very low since the fish abstain from feeding activity during the spawning season which coincides with the starting of the fishery. After December the fat content gradually goes down and by June-July it reaches the minimum.

Smaller sizes show low fat content since they are in a rapidly growing condition and as such do not have much of reserve fat. The critical length beyond which there is little increase in fat content is in vicinity of 16 cms.

The knowledge of fat content in different size groups of Oil Sardines during various seasons is important in planning the preservation and processing of the fish. Further work on these lines is in progress.

AMPHIBIA

127. On the Diet and Feeding Habits of the Common Toad, *Bufo melanostictus* Schneid.

B. K. BEHURA, P. K. DAS, Miss P. MOHANTY, Cuttack
and G. S. GHOSH, Puri.

One hundred and forty-four adult *Bufo melanostictus* Schneid, were captured in two localities of Cuttack during May and June, 1959 and the stomach contents examined. The female toads, seventy in number, varied from 3.85 cm. to 10.2 cm. in length with an average of 7.6 cm., while, the males 74 in number, ranged from 5.2 cm. to 9.0 cm. with an average of 7.2 cm.

Five stomachs were empty. In seventy-nine stomachs were 340 adult beetles of which sixty were *Bruchus chinensis* L., and four larvae; in two stomachs four adult pentatomids; in sixty-four stomachs 340 adult diptera, fifty-nine maggots and a large number of eggs, a single stomach containing eighty specimens of the common house fly; in 92 stomachs 1,905 ants; in 29 stomachs 31 adult Orthoptera of which eleven were *Periplaneta americana* and one *Grylloblatta africana* K., 12 nymphs and one egg case; in fifteen stomachs twenty-two earwigs; in three stomachs three Thysanura; in three stomachs three Isoptera; in two stomachs two adult moths and a larva; in ten stomachs ten spiders; in fifteen stomachs nineteen centipedes and five millipedes; in a single stomach a dragon fly; in one stomach a Collembola; in one stomach a Crustacea and in two stomachs were two gastropod shells.

Eleven stomachs contained moulted skin of toads, two stomachs each containing an entire bundle of moulted skin; forty-two stomachs had sand particles and small pebbles; 4 stomachs pieces of charcoal and coal; fifty stomachs dry or green vegetable matter; eight stomachs ten pieces of feather; two stomachs two pieces of thread; a single stomach a piece of paper; twenty-one stomachs paddy and paddy husks; one stomach a grain of wheat; five stomachs rice; one stomach 1½ rice; a single stomach a brinjal seed; four stomachs fourteen chilli seeds and a single stomach two leaves of horse radish (*Moringa*).

Fifty-two nematodes were recovered from twenty-eight stomachs.

The feeding habits of *B. melanostictus* are discussed.

128. On the oesophageal artery in *Bufo melanostictus* Schneid.

G. S. GHOSH, Puri.

The first, of the three branches of Occipito-vertebral artery, on such side, in common Indian toads, *Bufo melanostictus* Schneid, comes to the rescue of supplying the oesophagus, in as much as the solitary left Oesophageal is quite insufficient to feed the whole of it. As such, the conventional nomenclature of Occipito-vertebral should be changed to Oesophageo-occipito-vertebral, its branches to oesophagus as anterior oesophageal and the solitary oesophageal directly from the Systemic as the posterior oesophageal. The normal distance between the root of the subclavian and the posterior oesophageal is approximately twice that between the latter and the union of the systemics. The anterior one-third of the oesophagus is supplied by the anterior oesophageal, the middle one-third by the first branch of the posterior oesophageal and the posterior one-third by the second branch of the latter. The occurrence of the posterior oesophageals in pairs, is concurrent with that of a similar pair of anterior oesophageals. The absence of posterior oesophageal on the right side follows the prominence of the right anterior oesophageal and vice versa.

129. A Technique for the Dissection of the Nervous System of Vertebrates.

G. S. GHOSH, Puri and B. K. BEHURA, Cuttack.

For morphological studies of the brain of vertebrates, the skulls can be decalcified if the severed heads of the specimens are treated with a solution of 4% formalin 25 parts, 70% alcohol 60 parts, conc. HCl 10 parts and 4% KOH 5 parts for periods given under :

Toads and frogs—24 hours; Lizards—48 hours and mammals (guinea-pigs)—72 hours. The heads after treatment are washed in 70% alcohol saturated with lithium carbonate and then can be left indefinitely in 70% alcohol for dissection according to convenience.

In order to trace the origin and distribution of cranial and spinal nerves as well, entire specimens or in part after treatment in the above manner are treated with a solution of glacial acetic acid 10 parts and 70% alcohol 90 parts for periods varying from 24 hours to 72 hours depending on the size of the specimens. The treatment makes the nerves clear white which are easily traced out.

If the specimens are first treated in aceto-alcohol and then in the décalcifying fluid, better results are obtained with regard to the clearing of the nerves, but the liver, spleen and gonads become extremely soft and delicate.

130. On the Presence of Specialized Tissue in the Heart of the Frog *Rana Tigrina*

SATISH CHARAN MOWAR, Bhopal.

The presence of impulse initiating and conducting structures in the amphibian heart has been confirmed. Sinuatrial node and atrio-ventricular bundle are present at the interatrial septum at its cephalic and caudal ends respectively. The interatrial septum has been regarded as the pathway for the conduction of the contraction stimulus from the sinuatrial node to the atrioventricular bundle. The atrio-ventricular bundle has been regarded to be responsible for transmitting the contraction impulse to the ventricle.

REPTILIA

131. Studies on the Arterial System of *Varanus monitor* (Linn).

S. P. BHATNAGAR, Bhopal.

The arterial system of *Varanus monitor* has been thoroughly studied and its detailed account is given. Some important facts have been observed. A carotis primaria is present. The arteria carotis communes gives off seven factors. The arteriae lingualis are two—an anterior and a posterior. The arteria carotis externa is comparatively less developed. The arteria carotis interna divides into an arteria stepedials and an arteria cranialis. The arteria cranialis sends out an arteria cereberalis into the cranium and an arteria palatinus to the roof of the buccal floor. The arteria epigastrica communes arises from the carotis primaria. The right systemic arch is the continuation of the systemo-carotid beyond the place of origin of carotis primaria. The left systemic arch arises from the ventricle on the right side of the systemo-carotid arch. The arteria epigastrica media is described. The arteria gastrica arises not from the left systemic arch but exactly from the place where the two systemic arches unite to form the dorsal aorta. The arteriae parietales are fourteen to fifteen pairs. There is a single pair of arteriae renales arising from the dorsal aorta between the two kidneys. The left arteria dorsolumbalis arises from the dorsal aorta while the right from the arteria iliaca communis. Each pulmonary arch on entering the lung divides into a ramus posterior and a ramus anterior.

132. "Contribution to the Systematics, Distribution and Ecology of the reptiles of the Desert of Rajasthan, with special reference to the ecology of certain lizards".

K. C. DAVE, Jodhpur.

Observations on the home range, territory and homing behaviour of spiny tailed lizard, *Uromastix hardwickii* Gray, the common brown spotted skink, *Mabuya*

macularia Blyth and the desert monitor *Varanus griseus* Daudin have brought out certain interesting features. The paper records for the first time in India the detailed investigations of this aspect of the desert saurians. These lizards do not wander about at random. Their cruising is always with some motive : to feed or to mate. Home range is established by them in the same ecosystem, but may overlap different associations or biotic districts.

Home range of *Uromastix hardwickii* Gray extends from 64 meters to 111 meters. *Mabuya macularia* Blyth cruises from 23 meters to 47 meters, whereas *Varanus griseus* Daudin travels from 188 meters to 250 meters.

The size and shape of home range varies in individuals. Fluctuation in home range of lizards is both diel and seasonal. The change in shape and size depends on many factors. The limiting master factors are food and mate. Home range of these lizards is shortest in June-July (*Uromastix hardwickii* Gray travels within an area of 64 meters to 70 meters, *Mabuya macularia* Blyth moves up to 23 meters to 27 meters and *Varanus griseus* Daudin cruises a distance of 188 meters to 203 meters) and the longest in April (*Uromastix hardwickii* Gray travels a distance of 107 meters to 111 meters, *Mabuya macularia* Blyth moves as far as 33 meters to 47 meters and *Varanus griseus* Daudin extends its home range from 243 meters to 250 meters).

Mabuya macularia Blyth does not defend any area in the home range. The spiny tailed lizard, *Uromastix hardwickii* Gray, however, defends the home site only. Female *Varanus griseus* Daudin defends a part of the home range during breeding season, particularly after laying eggs. A territory (8 meters to 19 meters) is established by each female around the nest. Male *Varanus griseus* Daudin defends only the home site and the immediate area around itself, and so also a female.

Homing instinct is very well developed in *Uromastix hardwickii* Gray and *Varanus griseus* Daudin. As compared to these lizards homing instinct is less developed in *Mabuya macularia* Blyth. About 91% to 99% adult *Uromastix hardwickii* Gray, 80% to 88% adult *Mabuya macularia* Blyth and 96% to 99% *Varanus griseus* Daudin occupy the same burrow under all conditions. In juveniles this instinct is less developed; 80% to 93% juvenile *Uromastix hardwickii* Gray, 32% to 75% juvenile *Mabuya macularia* Blyth and 84% to 92% juvenile *Varanus griseus* Daudin occupy the same burrow.

133. The Skull of Indian Gharial, *Gavialis gangeticus* (Gray).

JAGADISH PRASAD, Bhopal.

Gavialis gangeticus being the oldest of old living crocodile exhibits transitory cranial modifications of pedigral importance. The skull is typically lorication, degraded diapsidan, monimostylic, tropobasic and amphikinetic in nature. A marked tendency towards the swift elimination of the upper temporal vacuity comparable to a condition met within *Cynognathus*, *Theromorphs* and modern lizards is worth recording. This obliteration is by way of the osseous otic elements. There is an osteocranic process anterior tecti, separate supratemporal and postorbital, independent vomeronasal organ and septomaxillary, and orbitotemporal buttress and the temporal origin of the depressor mandibulae as Rhynchocephalian, Chelonian, Stegocephalian, Dinosaurian and Ichthyopsidan affinities in conformity with its persistent longevity.

134. Studies on the Osteology of the Skull of *Python Morulus Morulus* (Badome).

PREM CHAND JAIN, Bhopal.

The skull of *Python m. morulus* (Badome) exhibits unique contradistinctive features which single it out from other snakes. The osteocranium typifies ophidian, streptostylic, platytubic and amphikinetic specialization. The architecture of the temporal space offers impressive illustration of a modified diapsidan variety. The monocondylar occipital condyle is exclusively basioccipital in origin. There is a prominent parietal crest besides paired parietals forming a casque. The aborted prefrontal has absence of lacrimo-prefrontal union. The processus nasalis of the premaxilla delimits the nasals. Both septomaxillary and vomeronasal sacs are distinct, a salient Saliential feature. They are significant in the uprising of the preorbital region of the skull movements. The members of the circumorbital series though compressed but entire and separate cranial entities. The lacrymal is distinct with a foramen lacrymale. The supraorbital arch creates a little drift in the postulated phylogeny of the group. The orbit coalesces with the temporal space as the temporal process of jugal is atrophied. There is a marked degeneration of the auditory apparatus. The main cranial constituent of this region being a triradiate preotic beset with foramen rotundum and ovalis with which the columella auris traverses. The persistent columella cranii and the synovial joint at the basipterygo-ptyergoid is worth mentioning in attributing the skull kinetism. The splenial is an additional bone in the mandibular ramii. The dentition is both acrodont and pleurodont.

135. Studies on the Skull of *Gonotodes Littoralis*.

PREM CHAND JAIN, Bhopal.

The skull of *Gonotodes littoralis* presents a tripartite nature of ramiform monocondylar occipital condyle. The processus anterior tecti is osteocranic. The parietal foramen lies in the centre of bivelled fronto-parietal edge. The vomeronasal foramina is posterior to the choanae. There is a distinct lacrimo-frontal union and the supraorbital arch. The members of the circumorbital series are compact and reduced. The orbitotemporal buttress (orbital process of post-orbit + temporal process of jugal) separates the orbit. The temporal fossa is embedded within the spacious supratemporal vacuity. A mucronated remnant osseous element from the jugal reveal quadratojugal. The temporal ratio is variant. The auditory apparatus exhibits tympanic cup on the wingy expansion of the quadrate. The extra-columellar structure is prominent. A pterygoprevomerine continuity similar to that in Rhyncocephalian persists. The pterygo-transpalatine projection meets the processus mesetericus of the coronoid. The craniology illustrates advent features transitional to Ithyopsida, Rhyncocephalia and modern lizards. The skull is lacertilian, streptostylic, metakinetic, tropobasic and modified parapsidan type.

136. On the Presence of Atrioventricular Bundle in the Heart of *Varanus Monitor* (Linne).

RAVI PRAKASH and RAJENDRA SAHAI, Bhopal.

Recent controversy with regard to the presence of specialized impulse initiating and conducting structures in the heart of lower vertebrates has necessitated a re-examination of the conducting (connecting) tissue of the heart of a lower vertebrate. The minute anatomy of the tissue that connects the different chambers of the heart of *Varanus monitor* has been studied and described. Sinuatrial and

atrioventricular nodes are absent in the heart of *Varanus*. The atrioventricular bundle is the only specialized tissue that could be traced and described. The structure and position of this bundle in the heart of *Varanus* suggests that like the bundle of His of birds and mammals, it is responsible for the transmission of the cardiac stimulus of contraction from atria to ventricle. Purkinje fibres and cells were observed in the atrioventricular bundle.

AVES

137. Histological Observations on the Oviduct of the Pigeon, *Columba livia* Gmelin .

K. P. CHAKRAVORTI and D. P. SADIHU, Calcutta.

This paper deals with the histological structures of different regions of the left oviduct and rudimentary right oviduct of the adult (laying) pigeon.

In general, the histological structures of the reproductive tract of the pigeon are similar to those of the fowl.

Tubular gland cells in the corium of the vagina, though absent in fowl, are present in the pigeon. Possibly this is related with the formation of outer shell cuticle and pigmentation of the egg. The lining epithelium of the uterus and vagina of the pigeon is composed of more than one layer of cells. Lymphocytic aggregates are present in all parts of the left and the right oviducts. There is no relationship in respect of the distribution of the lymphocytic aggregates in different regions of the oviduct. Lymphocytes may give rise to the plasma cells. Absence of tubular glands in the right rudimentary oviduct may be caused by the failure of estrogen to influence the invagination of the surface epithelium. High vascularity of the oviduct seems to be in accordance with the high metabolic activities of the flying bird like pigeon.

138. Significance of the 'Palate Index' and Orbito-Temporal Region in the Skull of Raj-Gidh of Bhopal, *Sarcogyps Calvus* Scop.

JAGDISH PRASAD, Bhopal.

The craniology of *Sarcogyps* offers impressive illustration of a tendency towards retention of the more primitive features. Thus a osteocranic maxillopalatine, small and distinct basipterygoids with interarticular fibrocartilage connexions together with a separate vomer, parasphenoid (basitemporal) and hemipterygoid to represent the pterygovomerine contact are unique specialization of this bird. From a comparative stand point its palate structure is quite contradistinctive from other contemporaries of the group. The fact that similar continuity of a complete set of the members of the circumorbital series with lateral lines to use as reference marks coupled with an aversion in the orbit coalesces with the temporal space in the occurrence of a well developed orbital and lacrymal projections and an aborted foramen retrotemporalis with a remnant elevated posterior arcade invariably exists irrespective of the perfect and complete presence of the superior and inferior arcades and vacuities. They attribute to the archiac significance of *Sarcogyps* in evaluating its derivation and in determining the course of evolution followed after it.

139. Influence of Sex and Maturity on the Histologic Structure of Suprarenal Glands of Pigeon.

D. SINHA, IRA RAY and A. GHOSH, Calcutta.

Histological structure of adrenal glands in the mature and immature male and female pigeons has been described in details.

Irrespective of the age and sex, the stroma is mainly composed of collagenous and reticulin fibres. Outer capsule contains various inclusions like, blood vessels, nerve ganglia, extrinsic ducts of gonads and cortico-medullary patches.

Glandular parenchyma consists of intermingled patches of interrenal and medullary tissues. Relative percentage of cortex and medulla measured by planimetric method reveals a definite higher proportion of the former in the adult pigeons of both sexes. *Interrenal*: The peripheral cells of the interrenal tissue are larger with considerable amount of cytoplasm than the central cortical cells. In immature pigeons nuclei of the peripheral cells are also much bigger in size than that of the central ones. The mature pigeons, however, do not show any significant difference in this respect. The interrenal tissue is mostly in the form of chords with a double row of cells, while one cell-thick peripheral strands are quite common in juvenile birds. In contrast to Miller and Riddle's (1942) observations, no definite nuclear polarity is noticed in our material. Shrunken morbid cells with pycnotic nuclei are present both in the central as well as in the peripheral cortical strands. The presence of yellowish-brown pigments, presumably lipofuscin in nature, in the interrenal cells characterises the adult suprarenal glands. The pigments are smaller at the central strands. *Medulla*: The medullary cells of all groups of birds contain an intensely basophilic granular cytoplasm with the irregular oriented nuclei. Medullary patches are intimately associated with blood spaces.

The probable significance of some intracapsular structures as well as the problems involving cytomorphism, nuclear polarity, cytogenesis and pigmentation in the interrenal tissue has been discussed.

140. The Connecting Tissue in the Heart of a Chick Embryo.

NAJMA YOUSUF and RAVI PRAKASH, Bhopal.

The cardiac connecting tissue of 8-day chick embryo has been studied and described. Sinuatrial node, atrioventricular node and rings of "Purkinje like tissue" have been observed. The atrioventricular bundle and the accessory atrioventricular muscular connections are absent on account of the slow rate of heart beat. The atrioventricular node is much more defined and distinct than the sinuatrial node. It is argued that in the latter stages of development the sinuatrial node would grow rapidly than the atrioventricular node to appear as a more distinct, prominent and well defined structure in the heart of adult birds.

MAMMALIA**141. Tracer Experiments in Small Mammals with Radioisotope Doses Equivalent to Man.**

R. BHATTACHARJI, SUBHAS R. BASU and FAZLE HOSAIN, Calcutta.

Difficulties are encountered in a number of tracer experiments in small experimental animals, such as rats, with radioactive isotopes specially when the dose of the isotope is used in equivalence to human subjects. It is necessary to measure

the radioactivity of small quantities of specimen samples, such as blood, urine, etc., which needs either the use of comparatively larger doses of the isotopes or the use of some moderately low level counting technique. In the present study some preliminary observations have been made on the thyroid function test with low doses, about $0.1 \mu\text{c}$ per rat, of NaI^{131} using an anticoincidence gas-low counter. The 24th hour percentage of protein-bound iodine in plasma was estimated for eight normal rats which ranged between 25-56.

142. On the Structure and Distribution of the Specialized Tissue of the Heart of Shrew.

S. P. BHATNAGAR, Bhopal.

The heart of shrew has been carefully studied. The structure and distribution of the specialized tissue has been described. A sinoatrial node, an atrioventricular node and an atrioventricular bundle with its two branches have been located and described. All these structures are formed of "Purkinje fibres". These fibres were also observed in the walls of atria and in the interatrial septum. "Purkinje fibres" are not present in the ventricles. The sinoatrial node is connected with the atrioventricular node by the "Purkinje fibres". The atrioventricular node is in free communication cranially with the muscle fibres of the interatrial septum while caudally with the atrioventricular bundle. An atrioventricular bundle has been observed to be the only tissue to connect the atria with the ventricles. It divides into right and left branches which run along the respective sides of the ventricular septum. No multiple muscular connexions of Kent could be observed. It is held that the cardiac contraction impulse which originates in the sinoatrial node would be conveyed to the atrioventricular node through the "Purkinje fibres" present in the interatrial septum. The atrioventricular node will pass the impulse after the necessary delay to the atrioventricular bundle which would distribute the impulse by its right and left branches to the respective sides of the ventricles. The myogenic theory of impulse initiation and conduction has been supported.

143. A Preliminary Report on Sweat Glands in Some Indian Cattle.

P. G. NAIR and B. R. BENJAMIN, Izatnagar

Hair follicles, sebaceous glands, arrector pili muscle and apocrine sweat glands together form the "Hair Follicle units". These structures have been described for the first time in India in *Haryana* cattle and *Kumaun-Hills* bulls, with special emphasis on sweat glands. Preliminary quantitative studies showed that in adult *Haryana* cows the glands were 0.418 ± 0.027 mm. long and had a surface area of 0.194 ± 0.014 mm.² and a volume of 0.00555 ± 0.00055 mm.³ The secretory surface was 2.6 times as large as the skin surface and the secretory volume was 7.45 mm.³ per cm.² of skin. The glands were smaller but more numerous in the younger animals. The growth in secretory volume per unit area of skin appeared to be continuous from birth to adulthood while maximum secretory surface per unit area of skin was observed in heifers.

Hill bulls had number of hair follicle units comparable to those in *Haryanas*, but the sweat glands were very much smaller.

The possible significance of these findings has been discussed.

144. A Preliminary Report on Sweat Glands in the Indian Water Buffalo.

P. G. NAIR and B. R. BENJAMIN, Izatnagar.

The "hair follicle group" of which sweat glands form a part has been described for the first time in Indian buffaloes. The sweat glands were typical apocrine glands shaped somewhat like a ground nut and there was always one to one relationship between sweat glands and hair follicles. Hence the number of sweat glands could be easily counted by counting the number of hair follicles.

The glands studied were slightly less than 0.4 mm. in length and slightly over 0.005 mm.³ in size, on the average. Of the two regions studied, the cheek had 188 glands per cm.² of skin while the middle portion of the last rib had only 84 glands. The corresponding values for secretory surface per square centimeter of skin were 0.348 and 0.157 square centimetres respectively.

These values suggest that if at all sweat glands have any thermoregulatory function, that function is very much less than in the case of Indian cattle.

145. The time of emergence of the Pipistrelle.

ISHWAR PRAKASH, Jaipur.

Among all the bats, pipistrelles are the first to start their activity rhythm at dusk and the time of their emergence is very regular. A small colony of Indian Pigmy Pipistrelle, *Pipistrellus mimus glaucillus* Wroughton was observed during the years 1956-1957-1958 at Jaipur, Rajasthan. The time of their first emergence from the roost was noticed and plotted against the time of sunset in various months of the year. The curve shows that the time of emergence of pipistrelle is directly governed by the time of sunset and accordingly to the intensity of twilight. All the three years the time of emergence in each month was constant.

The writer had a novel experience on May 27, 1959. The pipistrelles, which were flying their characteristic flight, disappeared at 7.35 P.M. and did not reappear. This untimely disappearance was quite significant. At 8.00 P.M. Jaipur was hit with a destructive, high speed storm. Similar incidents occurred on the evenings of 28th and 30th May 1959. The latter incidents confirmed relation between their disappearance and the storm. Can these pipistrelles be taken as indicators of Storm?

146. New Mammal records and Zoo-geography of Mammals in the Rajasthan Desert.

ISHWAR PRAKASH, Jaipur.

The Zoo-geographical studies show that certain mammals found in the desert of Rajasthan have affinity with those found in the deserts of the Palaearctic Region (*Hemiechinus auritus*, *Paraechinus micropus micropus*, *Taphozous perforatus*, *Vulpes vulpes*, *Herpestes auro-punctatus*, *Herpestes edwardi*, *Felis libyca*, *Mus musculus bactrianus* and *Meriones hurrianae*); while others closely resemble the mammals distributed in the forested areas of Oreintal Region (*Pteropus giganteus*, *Megaderma lyra lyra*, *Rhinolophus lepidus lepidus*, *Macaca mulatta*, *Presbytis entellus*, *Boselaphus tragocamelus*, and *Funambulus pennanti*) and some (*Suncus murinus sindensis*, *Antelope cervicapra rajputanae*, *Lepus nigricollis dayanus* and *Felis chaus prateri*) are endemic subspecies.

The following fourteen mammals have been reported for the first time from this desert :—*Pteropus giganteus giganteus*, *Rhinopoma kinneari*, *Taphozous kachhensts kachhensts*, *Megaderma lyra lyra*, *Rhinolophus lepidus lepidus*, *Pipistrellus mimus*

glaucillus, *Scotophilus heathi belangeri*, *Felis chaus prateri*, *Cervus unicolor*, *Boselaphus tragocamelus*, *Lepus nigricollis dayanus*, *Mus musculus bactrianus* and *Tatera indica indica*.

147. The Cranial Peculiarities of Didelphs, Opossum (*Didelphys crassicaudata*) and Bandicoot (*Peragale lagotis*).

JAGDISH PRASAD, Bhopal.

A prominent cavum internasale in Opossum and Bandicoot is remarkably interesting from phylogenetic stand point. It is comparable to the processus nasalis of Saurians and os carunculæ of monotremes. The egg-denticle protuberance of the cavum internasale are the vestiges of oviparity. In Bandicoot a separate interparietal with remenant interparietal foramen has been observed. The occipitosphenoidal region presents a median ossification. The foramen rotundum atrophies. The stapes are serrated and perforated. The orbito-temporal confluence is distinct. A sulcus cartilaginous Meckelli exist on the mandibular ramii. The Didelphian craniology reveals several features of reptilian origin.

148. The skull of an Indian Hyaena from Vaisali.

JAGDISH PRASAD, Bhopal.

This is the first complete skull of an Indian Hyaena to be exhumed from an excavated site. The skeletal remains are fairly well preserved and complete and come from the stratified deposits of Vaisali-Chak Ramdas, assignable to circa 500 B. C. The skull measure 160 m.m. in length. In view of the extensive modification of the upper carnassial it is estimated that the animal is fully grown ranging between 2½ and 3 years in age. The upper molar is reduced to a thin strip transversely placed and sharp on inner sides. The enormously dilated pelvis gives an impression that the individual was of *female sex*. The Zoogeography covers Central Africa and South-East Asia. The cranial peculiarities which differentiate it from the modern hyaena are.—

1. Broad skulled and shortened zygoma.
2. Large coronoid process of the mandible.
3. Enlarged fourth premolar tooth with protocone and rudimentary ectosyle, as a saber tooth adaptation.
4. Weak mastoid process and orbito-temporal confluence.
5. A tympanic bulla without rudimentary internal septum.
6. Strong jugal and the presence of Jacobson's organ.
7. The upper carnassial possessing three outer cusps and an inner cusp.
8. Mandibular suspensorium occurring along with gelenoid cavity.
9. The condylar foramen located behind the foramen lackrum postirius.
10. Dental formula is :—i 3/3; c 1/1; p 4/3; m 1/1.

It is distinguished by an additional premolar in the upper jaw.

The architecture and disposition of the skull bones reveal that this species is a transitory phase of phylogeny. The fact is that contemporary hyaena like the one in question existed as a transitory form to account for the admixture of features common to Civet and hyaena, prior to the final descent of recent hyaena materialized. The persistence of saber tooth adaptation as vestiges of forerunners is worth mentioning.

149. Laryngeal Skeleton and Musculature of *Hemiechinus Hemiechinus Auritus*.

D. R. SHARMA and K. K. VERMA, Lashkar.

This paper deals with the cartilages and the intrinsic muscles of the larynx of the Indian hedgehog, *Hemiechinus auritus*. The thyroid cartilage is C-shaped and opens dorsally. The articulation between its anterior cornu and the thyrohyal is a synchondrosis. The posterior cornu, on the other hand, is attached to the lateral surface of the cricoid cartilage by means of a ligamentous structure. The broad dorsal lamina of the cricoid is characterised by a keel from which the M. crico-arytenoideus dorsalis partly originates. The paired arytenoids are triangular elements situated on the anterolateral edges of the lamina of the cricoid. The entire skeleton of the larynx is cartilaginous.

The Mm. cricoarytenoideus dorsalis, cricoarytenoideus lateralis, cricothyroideus, thyroarytenoideus and interarytenoideus are described. The M. cricoarytenoideus dorsalis is very well developed in *Hemiechinus auritus*. The M. interarytenoideus represents the arytenoideus transversus part of the M. arytenoideus of man. The arytenoideus obliquus part is apparently not represented. The innervation of the individual muscles is recorded.

CYTOLOGY AND GENETICS**150. Chromosome Number and Sex-determining Mechanism in the Dragon-fly *Hemianax ephippiger* (Family : Aeshnidae).**

Miss SHANTA BAGGA, Delhi.

The study of the spermatogonial metaphases in *Hemianax ephippiger* reveals the presence of fourteen chromosomes (2 V's, 4 J's, 6 rods and 2 dot-like microchromosomes). A similar configuration consisting of fourteen chromosomes has also been observed in the follicular division figures in the terminal filaments of the ovary in the females.

The behaviour of the chromosomes during meiotic divisions shows a pattern of change similar to that reported in other Odonata. During pachytene, the chromosomes show regular pairing and seven bivalents are essentially counted in the nucleus. The first meiotic division is thus "reductional" for all the chromosomes of the complement.

In most of the members of Odonata, studied by various authors, an XO-XX mechanism has been recorded, while it appears to be different in the species under study. The fact that the diploid number of chromosomes is the same in both males and females of this species indicates the presence of an XY-XX sex-determining mechanism. It has been suggested by the author that a translocation involving an autosome and the single X chromosome in male might have given rise to XY condition during the course of evolution of the species.

151. Cytochemistry of an abnormal ontogenesis.

ASOKI BOSE, Jhargram.

Differentiation in a developing embryo is accompanied by synthesis of new substances. In the same way, developmental anomaly is expected to show corresponding substance-inactivation.

The cytochemistry of an abnormal ontogeny resulted by a delay in the initiation of incubation has been carried out. Localisations of three substances viz. alkaline

phosphatase, basophilia and DNA in the embryonic cells have been observed. A gradual loss of the substance localisation is seen with the growing abnormalities in the development. The time factor in the gradual denaturation of the substances within the embryonic cells resulting in the failure of organisation has been correlated.

152. Studies on structure and behaviour of Chromosomes during spermatogenesis of *Spathosternum* Sp.

NIRMALA CHATTERJEE, Patna.

A detailed cytological investigation on meiosis of *Spathosternum* sp. belonging to the subfamily Catantopinae of Acrididae has been presented in this paper. The diploid number of this species, which is thirteen, is the least so far reported in the Indian species of this subfamily. Two of these chromosomes are metacentric and the rest acrocentric. The amount of variation in the chiasma frequency and terminalization coefficient at different stages of metaphase I has been calculated. The data indicate that there is a significant movement of chiasmata and a proportionality between chromosome length and chiasma frequency in this species. The presence of an unequal bivalent and occurrence of syndiploidy showing triploid and tetraploid conditions during meiotic metaphase I constitute the meiotic abnormalities. A distinct cycle of heteropycnosis of X-chromosome has also been recorded.

153. Studies on the Cytoplasmic Inclusions of Neurones of *Pila globosa*.

NIRMALA CHATTERJEE, Patna.

The paper presents a detailed account of investigations on the Cytoplasmic Inclusions of neurones of *Pila globosa* by routine methods as well as by the authors' modification of Baker's sudan black B technique. All these methods demonstrated that there are three types of cytoplasmic inclusions, namely, mitochondria, the duplex (non-homogeneous) spheroids and homogenous spheroids in the neurones of this Gastropod. The duplex spheroid is made up of a chromophilic cortical component and a chromophobe medullary component. The cortical component, consisting of a cap, crescent, ring or granule, is intensely argentophil, osmiophil and sudanophil. The vacuolar medullary component does not react intensely to any of them. The duplex spheroids, therefore, are the Golgi bodies. The non-homogeneous spheroids associated with the paranuclear bodies, found earlier in the living neurones, and the duplex spheroids, seen in the fixed ones, are identical, the paranuclear bodies being the cortical components of these spheroids. The cortical component of the Golgi bodies, as revealed by sudan black technique, is lipoidal in nature. The duplex Golgi bodies and mitochondria are two distinctly different types of inclusions having no similarity either in living or fixed neurones. The former type is intensely argentophil, osmiophil and sudanophil but has no noticeable fuchsinophilia, whereas the latter type stains intensely with acid fuchsin and haematoxylin but hardly gives any positive reaction with silver, osmium or sudan black B. The homogeneous spheroids of living as well as fixed neurones appear to be products of the Golgi bodies.

154. Histochemical studies during the development of the Common English trouts—*Sulmo trutta* and *Salmo trideus* : iii Phospholipines, their location and function.

DAYA KRISHNA, Jodhpur.

Phospholipines have been studied in the yolk sac. Throughout the course of development from the time of fertilisation to the stage when the yolk-sac is absorbed and the fry starts feeding itself through mouth.

It has been observed that phospholipines are present in free form as well as combined with proteins forming lipo-proteins. Free phospholipines are concentrated in the center of the yolk-sac and from there, as development proceeds, they travel to the periphery through a particular route to play an important role in lipoid-utilisation. Also it has been observed that phospholipines are always present at the places where the embryo cells are in touch with yolk. These phospholipines are either from the center of the yolk-sac or are formed by the breaking of lipo proteins.

The function of phospholipines as an important component at the time of lipoid-utilisation by the embryo has been discussed.

155. Histochemical studies during the development of the Common English trouts—*Salmo trutta* and *Salmo irideus* : iv Lipo-proteins. their location and function.

DAYA KRISHNA, Jodhpur.

Lipo-proteins have been observed throughout the length and breadth of the yolk-sac. The lipoid part was always a phospholipine. They were the first to be utilised by the embryo and first to appear in embryo cells. There were significant indications that lipo proteins broke down and released phospholipines whenever required. They always broke down before being utilised by the embryo, and were newly formed in the embryo cells. Their functions in lipoid metabolism have been discussed.

An integrated summary of the location and functions of all the lipoid components has been given.

156. Sperm dimegaly in *Scolopendra amazonica* (Bucherl). (Family: Scolopendridae, Class : Chilopoda) .

C. R. PUTTANNA, Bangalore.

The morphology of the two kinds of sperms (micro- and macrosperms) produced from the two types of spermatocytes has been described. The length of sperm head in micro- and macrosperms is about 44μ and 245μ respectively. The middlepiece region (about 434μ) and the centriole are clear in the macrosperm but they are not visible in the microsperm. When stained in Feulgen's reagent the head of the microsperm gives a positive reaction while the macrosperm head is negative, indicating the absence of DNA. In iron haematoxylin the head of both stains. In toluidine blue preparations only the microsperm head stains blue while the macrosperm head is colourless, but the middlepiece region stains slightly pink. From the reaction of the sperms to Feulgen stain, it is inferred that the macrosperm may not be functional.

157. Sex chromosomes in the cotton stainer, *Dysdercus koenigii* (Fabr.) (Pyrrhocoridae, Heteroptera).

S. P. RAY-CHAUDHURI and M. R. BANERJEE, Calcutta.

Since the publication of Piza and Ray-Chaudhuri and Manna the problems of sex chromosomes and their behaviour in the genus *Dysdercus* have become a subject of much interest. Both the above mentioned authors have suggested the presence of X and Y sex chromosomes in the males of *D. memdesi* and *D. koenigii* respectively. According to Ray-Chaudhuri and Manna the sex chromosomes in the

males of *D. koenigii* move undivided to the poles in both the meiotic divisions and thereby effect a double reduction of the sex chromosomes.

This phenomenon of double reduction of the sex chromosomes in *D. koenigii*, has been reconsidered. A detailed study of the Oogenesis, cleavage and early embryonic divisions reveals that the species *D. koenigii*, has XXO and XXXX sex chromosomes in males and females respectively.

During spermatogenesis, the two X chromosomes after an equational division at anaphase I, come so close to one another that they appear as a single fused body. The females have 18 diploid chromosomes with XXXX sex determining mechanism while the males have $2n-16$ chromosomes with XXO sex chromosomes. Two types of embryos with 18 and 16 chromosomes have also been observed. The sex chromosomes in the males do not have a double reduction during spermatogenesis, but on the contrary behave in the orthodox heteropteran manner.

158. Bivalent segregation in natural population of *Poecilocera picta* (Acrididae).

B. R. SESHACHAR and C. R. PUTTANNA, Bangalore.

The atypical behaviour of bivalents during meiosis in untreated individuals of *Poecilocera picta* has been described. The phenomenon of bivalent segregation recorded earlier (Auerbach, 1947; Seshachar & Nambiar, 1955; Nambiar, 1955) was induced by chemicals. But such a phenomenon was found to occur (about 7.5%) in individuals of a wild population of *Poecilocera picta* collected in the vicinity of Bangalore, S. India. The possible method by which bivalent segregation is induced in a normal cell has been suggested. The fate of the secondary spermatocytes with bivalents has also been discussed. From this study it has been inferred that the phenomenon of bivalent segregation occurs in nature (in wild populations) with varying but low frequency. The use of chemicals like ethyl urethane, nitrogen mustard and sodium ribose nucleate hastens this frequency of bivalent segregation.

159. Studies on the structure and behaviour of the Chromosomes of the Scorpion *Palamnaeus longimanus*.

M. D. L. SRIVASTAVA and UMA AGARWAL, Allahabad.

The diploid chromosome complement of *Palamnaeus longimanus* consists of sixty-four elements.

In the spermatocytes the leptotene threads are fine and beaded. There is no synapsis and the leptotene threads eventually become a confused tangle of coarse threads carrying deeply stained masses. There is no diplotene and no diakinesis. The threads contract to give rise to dense, small chromosomes characteristic of metaphase in general. Just before metaphase, homologous chromosomes come together sideways, pairing without being in actual contact. At the full first metaphase, however, owing to extreme contraction and closer contact between the homologues, each bivalent appears as if it were a single element. At the first metaphase there are thirty-one chromosomal bodies, of which thirty are the ordinary bivalents and one is a complex figure consisting of four chromosomes sticking to one another by their extremities forming a cross-like figure. At the first anaphase, each pole usually, but not always, receives 32 chromosomes, which number is also maintained at the 2nd metaphase.

It can be supposed that the complex figure of four arises owing to reciprocal translocations between two of these four chromosomes. It is also possible there is nothing more than stickiness, due to heterochromatization, responsible for this.

160. Studies on the structure and behaviour of the chromosomes of the Scorpion *Palamnæus longimanus*.

M. D. L. SRIVASTAVA and U. AGARWAL, Allahabad.

The diploid chromosome complement of *Palamnæus longimanus* as observed at the spermatogonial and oogonial metaphases consists of sixty-four elements. In polar view, the chromosomes are observed to be scattered over the entire equatorial plate of the spindle.

In the spermatocytes, the leptotene threads are fine and beaded and become gradually condensed. There is no synapsis and the leptotene threads eventually become a confused tangle of coarse threads carrying deeply stained masses. There is no diplotene and no diakinesis. The threads contract to give rise to dense small chromosomes characteristic of metaphase in general. Just before metaphase, homologous chromosomes come together sideways, pairing without being in actual contact. At the full first metaphase, however, owing to extreme contraction and closer contact between the homologues, each bivalent appears as if it were a single element. At the first metaphase there are thirty-one chromosomal bodies, of which thirty are the ordinary bivalents and one is a compound figure consisting of four chromosomes sticking to one another by their extremities forming a cross-like figure. At the first anaphase, each pole usually receives 32 chromosomes, which number is also maintained at the 2nd metaphase. However, the chromosomes are not always distributed half and half to the two poles at the first anaphase; sometimes 33 chromosomes are received by one pole and 31 by the other.

It can be supposed that the compound figure of four arises owing to reciprocal translocations between two of these four chromosomes. It is also possible there is nothing more than stickiness in the extremities of these four chromosomes, due to heterochromatization, at the bottom of this. It must be remembered there is no synapsis and the question of specific pairing of chromosomal segments does not arise.

161. On the homology of the cytoplasmic organelles of the somatic and germ-cells of *Halys dentatus*.

M. D. L. SRIVASTAVA and C. C. DAS, Allahabad.

The polysaccharide material in the accessory gland cells of *Halys dentatus* is organized in the form of a network corresponding in detail to the Golgi apparatus in these cells as demonstrated by the classical techniques involving the use of silver nitrate and osmic acid. The correspondence is also found to a large extent in the male and female germ-cells and nerve-cells of *Halys dentatus*. Besides, the lipids as demonstrated by Baker's acid haematin test, Sudan black, Sudan III and IV, and Nile blue sulphate, correspond to the osmiophil and argentophil bodies. There is also a correspondence between the osmiophil bodies in the accessory gland cells and the alkaline phosphatase material. On account of the ubiquity of proteins, the cytoplasmic organelles do not stand out so sharply when demonstrated by methods which are calculated to show proteins, like Millon's tetrazolium and mercuric bromophenol blue methods. Nevertheless, there is a rough correspondence between the cytoplasmic bodies demonstrated by these methods and the osmiophil bodies. The mitochondria contain phospholipids and proteins, but no polysaccharides. It is contended that in view of these findings the term Golgi apparatus does not have to be abandoned.

EMBRYOLOGY**162. Effects of Cobalt Chloride on chick embryos.**

SIMANANDA ADHIKARI, Calcutta.

Effects of mitosis inducing substances on the organisation pattern of developing chick embryos have been studied. 0.5% Cobalt chloride constitutes the effective dose which has been administered into fertilised unincubated eggs. The end-results have been examined after 48 hours, 96 hours and 144 hours of incubation. Treated embryos of 48 hours depict a definite delay in setting up of organisation. Induction at this stage is lacking and neural tube, notochord and somites are absent. Even the germ layers fail to establish themselves properly. In embryos of 96 hours and 144 hours, the layout of the embryonic structures are well understood. The derivatives of ectoderm and endoderm are poorly designed while mesodermal structures show considerable over-development. The most significant point of this study is the occurrence of localised cell-death in the ectodermal and mesodermal tissues. Results have been discussed in terms of organisation.

163. Effect of Trypan blue on the inductivity and differentiation of head process and node.

LEELA MULHERKAR, Poona.

The effect of trypan blue on rats, mice, amphibia and chick embryos has been reported by a number of workers. Some of the abnormalities observed in Amphibia by Waddington and Perry consisted of the reduction of neural system and the suppression of the notochord. This reduction of the neural system might be due to the weakening of the inductive powers of the underlying mesoderm. An attempt is made in this paper to study the effect of Trypan blue on the inductive power as well as differentiation of the head process and node. Head process and node of the chick embryos treated with a suitable concentration of Trypan blue were transplanted into host chick embryos at the primitive streak stage. Transplanted embryos were cultured *in vitro*. It was found that the head process and the node treated with Trypan blue have a capacity for induction and differentiation.

164. Mitotic complex in the cardiac field of Chick Embryos.

SIVATOSH MOOKERJEE and NOORJEHAN BEGUM, Calcutta.

Mitotic phenomenon during individuation of cardiogenic material of the ventricle in chick embryo has been worked out. The rate and site of mitotic activity in the ventricle at different stages of development reveal certain features of interest. The study shows that the majority of cells in the cardiogenic field do not divide all at a time but only a few of them do. However, the mitotic frequency does not increase progressively along with the age of the embryo. Highest mitotic activity has been observed in the 13 day embryo (11.03%), the lowest being in the 21 day embryo (3.09%). The intervening percentages are 9.89 (3 day), 8.13 (6 day), 3.98 (9 day), 4.77 (15 day), 6.85 (17 day), 6.05 (19 day) and 10.21 (22 day). Though there is no definite proliferating zone, the rate of mitosis is more pronounced at the central area of the ventricle (excepting in the 3 day embryo where the condition is reversed). Mitosis provides the raw material for future histo-differentiation of heart.

Mitosis as a process in individuation has been discussed.

ENDOCRINOLOGY

165. Separation of Two Factors from Human Chorionic Gonadotrophin (HCG).

U. K. BANIK, Calcutta.

Human chorionic gonadotrophin (HCG) contains largely interstitial cells stimulating hormone (ICSH) and small quantity of follicle stimulating hormone (FSH). Partially purified HCG (4,000-4,500 I.U./mg.) was inactivated by mercuric chloride (HgCl_2) at a concentration of $1.5 \times 10^{-2} \text{M}$. Inactivated HCG-Hg complex was subjected to fractionation by increasing the concentration of chilled ethanol. Precipitates of every fraction was, however, inactive and the activity could be reversed by addition of cysteine and H_2S . At lower concentration of ethanol (between 30 and 50%) first factor was obtained and between 50 and 60% concentration of ethanol no hormonal activity was recovered. At higher concentration of ethanol (between 66.6 and 75.5%) second factor was obtained. Spermiation test in toad (*Bufo melanostictus*) was positive by both factors. Two factors were separately assayed in sexually intact immature female rats. Activity of the first factor was found to be more follicle stimulating in nature than the second one. It was suggested the H^{++} might combine, probably, with the $-\text{SH}$ group of the hormone and the use of buffered HgCl_2 was essential for the separation of the two factors at different concentration of chilled ethanol.

166. "On the Inducing Capacity of the Anterior Pituitary of *Rana breviceps* (Schneider) in Chick Embryos Cultured in Vitro".

GAJANAN V. SHERBET and LILLA MULHARKAR, Poona.

1. Grafts of fresh anterior pituitary of *Rana breviceps* were made into chick embryos at primitive streak stage explanted in vitro and cultured further.
2. Out of Sixteen grafts made nine caused induction.
3. The induction cases have been described briefly.
4. A relationship was observed between the size of the graft and the volume of the induced neural tissue. The measurements of the tissues concerned was made and graph plotted to show the relationship.

167. Action of Enzyme digested Skipper-frog Pituitary glands on the ovulation of the same.

L. S. RAMASWAMI and A. B. LAKSHMAN, Bangalore.

During the course of our studies on inducing spawning in lower vertebrates, we have reported about the action of mammalian hormones on the ovary of the catfish and of the skipper-frog. It is likely that the piscine pituitary gland also elaborates two kinds of gonadotrophins similar to the follicle-stimulating hormone and the luteinizing hormone of mammals. By suitable enzyme digestion experiments, we are now attempting to show that the anuran pituitary gland also elaborates similar hormones responsible for the growth and maturation of eggs.

The follicle-stimulating hormone may be inactivated or destroyed when the pituitary gland homogenate is incubated at 37°C . for 5-6 hr. with ptyalin; similarly the luteinizing factor is either destroyed or inactivated when digested with trypsin or pepsin. Untreated pituitary gland homogenate remains unchanged after incubation. In addition to parenterally injecting these homogenates, we have also injected combined doses of the trypsin digested and ptyalin digested homogenates, the former

retaining the follicle-stimulating factor and the latter the luteinizing factor to study their effect. Test animals receiving the control dose and of the combination dose spawned in the aquaria but those receiving the ptyalin digested homogenate spawned profusely indicating that luteinizing factor alone acts more effectively than when combined with the follicle-stimulating factor. The trypsin or pepsin digested homogenates did not bring about spawning.

The digestion experiments on the skipper-frog pituitary glands go to support the view that in the lower vertebrates, the luteinizing hormone plays a predominant role and is probably stored in the pituitary gland.

HYDROBIOLOGY

168. Hydrobiology of Suraj Kund, Delhi.

H. L. SARKAR and HAKUMAT RAI, Delhi.

An attempt has been made to study the physico-chemical conditions and biological contents of the Suraj Kund, a very ancient tank in Delhi. The history of this kund has been traced. It has been found to be a thousand years or more old. The kund is situated about 12 miles from Delhi and covers nearly a water area of six acres. It is 60 feet deep in the centre and has a small spring (Jhir) underneath. Extensive hydrobiological studies were made during winter, summer and premonsoon seasons. The seasonal variations in both macro and microflora and fauna were studied and have been correlated with the variation in the oxygen content of the water due to the changed physiological activities of the flora and fauna under different weather conditions. The water has been found to be alkaline. The maximum pH being 9.4 in March. Small quantities of phosphates, and fairly high content of silicates are noted. Nitrates and free carbondioxide have been found to be absent. High content of chlorides indicates the pollution of water. Hardness of water increases in winter and in summer and decreases in premonsoon season. The percentage of zooplankton varies from 14.2 to 51.2 and that of phytoplankton between 48.8 and 86.8. Fish life is found totally absent in the kund.

SECTION OF ANTHROPOLOGY & ARCHAEOLOGY

President :—PROF. M. L. CHAKRABARTY, M.Sc., M.B., PH.D. (Lond.)

Abstracts

PHYSICAL ANTHROPOLOGY

Anthropometry

1. The Pandit and Mahammadan of Kashmir.

T. C. RAYCHAUDHURI, Calcutta.

From an analysis of the anthropometric data of 206 Pandit and 52 Mahammadans of Kashmir it is seen that they are practically alike in physical characters. Both of them are medium in stature, dolichocephalic, hypsiccephalic, acrocephalic, lepto-prosopic, lepten, leptorrhine, pro-opic with reddish brown skin colour, black shallow wavy hair, fairly thick on the head and face and body hair scanty, moderately arched crown and occipital region, oval face, sub-medium to medium angle of the lower jaw, malars not prominent, lips without any eversion, non-prognathic face, straight, brown to fairly brown eye with medium opening, eye brown thin or of medium thickness and not connected, nasal bridge either convex or straight and root of the nose is moderately depressed, and of either weak or of medium constitution corresponding to hyponic or normal constitution type of Martin.

It appears that they represent a Mediterranean type whose zone stretches from Spain in the west, through Morocco, East Africa, Arabia, Mesopotamia, Persia, Afghanistan into India and that the "purest nucleus" of the Mediterranean race is to be found in Arabia.

2. A preliminary study of Onge cranial and skeletal materials from Little Andaman.

PABITRA GUPTA, ARABINDA BASU and ANIMA GUPTA, Calcutta.

The importance of the study of the Onge skeletons need not be emphasised too strongly, considering the ethnic homogeneity of the isolated negrito population of Little Andaman. Probably there is no previous record of any osteological study of this little known tribe, although the neighbouring Andamanese with whom they possess affinity, have been investigated by eminent anthropologists.

Two adult female skeletons, which form a part of the collection of the Department of Anthropology, Government of India, have been reported in this paper. When remaining collection is available, a thorough and detailed study might expose many characteristic features. The external morphology of the skulls shows general uniformity in shape, size and contour. The skulls are microcephalic, brachycranial (one is hyper-), hypsicranial, with high orbits, low and broad face and prominent cheek bones. Some infantile features and certain primitive characters from evolutionary stand point are evident. Among other peculiarities the most noteworthy feature at the base of the skull, which does not show much complication, is the mandibular articulation. Big glenoid cavity provides evidences for rotatory motion

in mastication, and the Glaserian fissure (petrotympanic fissure) is remarkable with two distinct lips as well as the tympanic plate is broad with sharp margin. Attrition of teeth indicates rough food habit. In one skull 3rd molar has not erupted although quite adult.

Most interesting feature is the presence of certain Mongoloid traits viz. shovel shaped incisors, broad and flat nasal roots, marked projection of molars etc. which cannot be explained before the mechanism of inbreeding and outbreeding (if any), isolation and other forces responsible for evolution are thoroughly investigated.

3. A comparative study of the Somatic and Somatoscopic characters and their Racial affinities of the tribal population of Kerala.

B. K. CHATTERJI and G. D. KUMAR, Calcutta.

The analysis of different somatometric and somatoscopic observations revealed the presence of the following characters among the tribal populations of Kerala. They are short statured, having dolichocephalic heads, but the presence of mesocephal and brachycephal was also found among them, particularly among the Malapantarams and the Paliyans. Though the prevailing type of nose was mesorrhine, still the presence of Leptorrhine and Platyrrhine was also equally high, thereby indicating the presence of admixture among them. The prosopic type of facial character was the prevailing type, but among the Paliyans and the Kuravans, the occurrence of Platyopic and Mesopic types was considerably high. Lepten was the predominating feature among them, except the Paliyans and the Uralis where the eune was the dominating type. It was interesting to note that euryprosopic, mesoprosopic and leptoprosopic types of total facial characters were evenly distributed among them.

The complexion varied from colour Nos. 22 to 29, after von Luschan's skin colour chart but the highest percentages were found in colour nos. 25 and 26 i.e. dark shades of chocolate brown. The character of head hair was generally straight but the percentage of curly hair was not negligible. In the case of the Uralis and the Kannikar the presence of frizzly hair was also observed. Body hair was found absent in the majority of the peoples. Eye colour varied from colour Nos. 1 to 2 after Martin's Eye colour chart and eye form was found straight but slightly oblique eyes were also present among them. Epicanthic fold was totally absent among different tribes, strongly marked supraorbital ridges were not observed in majority of cases but marked ridges, particularly towards the peripheral region were noticed among them.

The percentage of the presence of alveolar prognathism was also not negligible, particularly among the Uralis and Paliyans. The presence of nasal depression was high among them. The profile of the nose varied from No. 2 to 13, after Martin's Nasal profile chart, having highest concentration in Nos. 7 to 12 i.e. variations of concavo-convex types. The lips were generally thick and the presence of medium lips was also present. The majority of the chin were found neutral except in the case of the Malapantaram where the majority of chin were positive. The lobules of the ear were not free among considerable number of the people and the Darwin's point was present among certain percentage of population.

The tribal population of Kerala is not racially pure and miscegenation had taken place among them to a considerable extent with different peoples apart from the higher caste of people of South India. It also appears that the hill tribes are racially akin to the Irula, Kadar, Pulayer, Munda, Iluva and the Veddah.

Heredity and Genetics

4. Dermatoglyphics of the Uralis of Kerala.

MANISH RANJAN CHAKRAVARTI and PABITRA GUPTA, Calcutta.

The Uralis are a very short statured people with long head, medium long face and medium nose. Their total population, according to 1931 Census, is 916 (males 454 and females 462). Their main distribution in Kerala is in the Thodupuzha range, Kumili range, Game range and Neriamangalam range.

The dermatoglyphic study of the Uralis consists of 84 individuals (males 60; females 24). Males show 53.49% whorls against 46.51% loops (Radial loops—1.02%) with no arches, while females show 44.30% whorls against 54.43% loops (Radial loop—0.84%) with 1.27% arches.

The predominant main line formulae in both the sexes is 7.5.5—(males—40.34%; females—47.92%). The formulae 11.9.7—occur in 20.17% in males and in 14.58% in females. The latter sex shows a higher frequency of the formulae of 9.7.5—(22.92%) than males (12.61%).

A detailed investigation of the other dermatoglyphic characters has been made.

5. Inheritance of Ear Lobe.

INDERA P. SINGH, Delhi.

One hundred families with 416 children have been studied in order to determine the inheritance of ear-lobe. Distinction has been made between the presence of a large lobe and a small lobe as well as its absence. We find from the analysis of the data that a predominant majority of the offsprings of the parents having large ear-lobe also show large ear-lobes. On the other hand offsprings of the parents showing no ear-lobe also do not show them. The number of children not possessing ear-lobe increases with a similar increase of parents not showing the ear-lobe. Tables showing the presence and absence of ear-lobe of offsprings of different parental combinations with disregard of small or large ear-lobe have also been prepared. A significant result to be noticed from this table is that more than 90% of children of both parents possessing ear-lobes also possess ear-lobe. While more than 95% children of parents not possessing ear-lobe also do not show any such lobe. The mode of inheritance of the presence of ear-lobe seems to be dominant over the absence of ear-lobe. χ^2 test has been applied to test the significance of this statement and it (0.2765) was found that the difference between the observed and the expected frequency is non-significant.

6. Inheritance of Handedness.

INDERA P. SINGH and DARSHAN S. SAINI, Delhi.

One hundred families with 416 children belonging to Punjab have been studied in order to determine the inheritance of handedness. Right handedness or left handedness was judged on the basis of questionnaire framed after Falek, and some practical tests given to the subjects.

Eightyfive parental combinations of Right handedness \times Right handedness ($R \times R$) were obtained in our data, 96% of the offsprings of these parental combinations also show right handedness. No sex differences are to be noticed. Only fifteen parental combinations of Right handedness \times Left handedness ($R \times L$) type

occurred in our data. 25% of the offsprings of these parents also show left handedness while 3/4th of them were found to be right handed. No parental combination of Left handedness \times Left handedness ($L \times L$) was noticed. It is quite evident that the right handedness is dominant over the left handedness. χ^2 value (2.98732) shows non significant difference which proves our hypothesis.

7. Genetic study of human eye brows and eye lashes.

INDIRA P. SINGH and DARSHAN S. SAINI, Delhi.

Genetic studies have been made on one hundred families of two generations with 416 children with respect to eye brows and eye lashes. The eye brows were distinguished into a. Spreading; b. Even; c. Double; d. Narrowing; e. Peaked; f. Sheading; g. S-Shaped; h. Rising; i. Falling; j. Arched; k. Irregular types according to Rozprym. It was noted that the children tend to show similar kind of eye brows as their parents have. It is noticed that the male children tend to show Spreading type and the female Even.

The presence of concentric and eccentric whorls or its absence was noted. It was found that when both the parents showed concentric whorl most of the children also displayed concentric whorls. The largest number of families were noticed in the absence \times absence type of parental combination, while most of the female children showed absence of the whorl, half of the male children showed either concentric or eccentric whorls. The presence and absence of whorls seems to be due to an incompletely dominant gene.

Two colours of eye brows were noticed, black and brown. When both the parents have black eye brows, more than 99% children also have black eye-brows. When one parent has black eye brows and the other light brown, half of the children show black eye-brows and the other half light brown.

Eye lashes were distinguished into (1) Long curved upwards, (2) Long straight, (3) Short straight, (4) Short curved upwards, (5) Hooked types. It was found that the children tend to show similar kind of eye lashes as their parents. However long curved upwards eye-lashes seems to be dominant over the long straight. In the various combinations we find that the children display largely long curved upwards type of eye lashes. Eye lashes seem to change their direction and length with age. While no person above the age of 36 shows long curved upwards eye lashes, a predominant majority below 36 shows long curved upwards type of eye lashes.

8. Study of Blood Groups, Abnormal Haemoglobins and other Genetical characters in six tribes of Gujarat.

G. N. VYAS, H. M. BHATIA, P. K. SUKUMARAN and L. D. SANGHVI, Bombay.

Over a period of last three years field studies were undertaken to investigate ABO, MN, Rh (including sub-groups), Duffy and P blood groups, taste reaction to Phenyl-thio-carbamide (p.t.c.), secretion of group specific substances in saliva, red-green colour blindness, sickling test by wet preparation and abnormal haemoglobins by paper electrophoresis amongst the tribes of Gujrat. 150 to 200 unrelated subjects from each tribe were investigated and the blood and saliva samples were brought over to Bombay for testing at the Indian Cancer Research Centre. The tribes included (1) Kolis, (2) Naika, (3) Dhodia, (4) Gamit (from Surat District), (5) Bhil of Panchamahar, and (6) Dhanka of Rajpipla.

This extensive study has just been concluded and the data will be presented in some detail.

9. Distribution of ABO Blood groups and the ABH secretion in saliva in the Banias of Delhi.

SWADESH ANAND, Delhi.

The ABO and the ABH secretor factors were investigated for 580 Banias of Delhi. The analysis of blood group study indicates that group B is more prevalent than group A, while group O, as in most of the cases is quite high in the percentage frequency distribution of the four blood groups.

Five hundred and eighty individuals were studied for ABO blood group. The gene frequencies were as follows :—

$$A=0.157, B=0.283, O=0.556.$$

Same amount of saliva samples were tested for secretion of ABH substances. The secretor gene frequency was obtained as 0.5766 and non-secretor gene frequency was 0.4234.

It is very interesting to note however that serologically the Banias of Delhi show great affinity to the other people of Central India. But regarding distribution of secretor gene, the population differs from Bengalis and Malids.

10. A Genetic Survey in the Garhwalis of Pauri Garhwal.

SWADESH ANAND, Delhi.

An anthropological survey was carried out amongst the people living on the hills of Pauri Garhwal. The present paper discusses the result of ABO blood groups and A-B-H secretions in saliva. The ABO blood grouping results correspond well with previous findings. The population shows high percentage of B. The incidence of the classical blood groups was studied on 185 Garhwalis, where the distributions of genes are as such :—

$$p=0.217, q=0.228 \text{ and } r=0.551.$$

The various ethnic groups of India show remarkable differences in the ABH secretion. Similarly the people of hills of Garhwals are very high in secretor gene (87.5%).

Conclusion as to the racial composition can only be drawn when more material from whole India and also other parts of the world has been collected and analysed on the same basis.

11. The Study of ABO Blood Groups of Sainis of Punjab.

INDERA PAUL SINGH and DARSHAN SINGH SAINI, Delhi.

This article deals with the study of ABO groups of Sainis, a gardening and cultivating tribe of Punjab and their relationship with others.

Very high B gene frequency, namely 0.2633, is noticed which is in consistence with the distribution of the gene in this region. They are not found to be significantly different from other groups for ABO of Punjabis.

PREHISTORIC ARCHAEOLOGY**12. Stone Age Sites around Nagpur (Bombay State).**

R. V. JOSHI, Nagpur.

In the last year the author surveyed portions of the Nagpur, Wardha and Bhandara Districts and discovered several sites yielding flake-blade-scraper type of artefacts (Series—II of Sankalia) on the Wainganga, Kanhan and Wuna rivers. A well stratified grave on the Wuna yielded several tools 'in situ', while at a place Koradli they were found in the vicinity of the outcrops of chert beds and vein quartz. Although no difference in the raw material, or in common tool types is apparent between this and similar industries in other parts of India, these collections usually show a higher percentage of tools made on blades.

The types of artefacts show typological similarity with the Smithfield—A (Africa) as far as the technique of producing flakes and the types of tools, such as scrapers (particularly hollow scrapers) are concerned. They have the elements of the Mousterian culture of Europe (Side scrapers) and its African variant-Aterian (points). On purely typological evidence the industry perhaps suggests technotypological level falling between (1) the Middle-And Late-Stone Ages of Africa, and (2) Levallois—Mousterian (Aterian) of Europe.

13. Middle Stone Age Sites from Kaira District in Gujarat.

K. V. S. RAJAN, Baroda.

The paper deals with the Middle Stone Age culture sites discovered by the author along the Mohor river (an affluent of the Vatrak—a major tributary to the Sabarmati river) flowing along Kapadvanj town in Kaira District. Flake tools from two sites on this river have been collected, of which the site near Mahamadpura reveals the basic stratigraphy also. The flake tools had been picked up 'in situ' from the 20 ft. terrace on the right bank near Mahamadpura, above which lies the heavy loessic loam which had yielded here and there a few microliths on its top. There is no other tool horizon below the 20 ft. bench.

The industry is characterised essentially by flake-blades, scrapers, points and cores both of the prepared platform variety as well as atypical multi-directional and fluted variety. The material of the tools is mainly agate and chert found in plenty in this area, besides rare specimens on vein-quartz.

Practically no important Middle Stone Age site has been noticed from Gujarat proper till now, although both Sabarmati and Mahi had revealed many early Stone Age and microlithic localities.

CULTURAL ANTHROPOLOGY**14. Castes' Unrest.**

P. K. BHOWMICK, Calcutta.

The four fold Varnashrama divisions of the Hindu social structure have deep-rooted influence on the traditions of the people of all economic grades in India. There had been persistent conflicts amongst these sects with regard to their rights and privileges according as a particular group suffered certain disabilities thwarting their scope of self-assertion and advancement in the economic as well as social spheres.. The trend of this conflict followed the pattern of crusade to shake off the orthodoxy which has pegged them to a lower status for centuries. With the

demands of the age and growth of new ideas, the nature of the struggle changed from time to time in course of which integration and disintegration, co-operation and non-co-operation amongst the individuals played a significant part. Scheduled caste communities are composed of different sizes of population with distinct occupational trends and professions and they have their specific problems of social life.

The writer tried to study the following Scheduled caste communities in Midnapur to focuss the trends of changes amongst them. They are Paundra Kshatriya, Namasudra, Rajbanshi, Dom, Hari, Muchi and the Chitrakar (not the scheduled caste). Some of these communities are seriously attempting to raise their social and economic status to fit them up with changes and adjustments in the social order. It is to be particularly noted here also how individual efforts and group and communal endeavours have affected their ways of life from time to time in perceptible degrees. Sometimes well-to-do persons of a community take the lead and they form one social status of their own at the end of such movements. Details have been described by the writer in this paper.

15. The Baiga of Madhya Pradesh (A Psycho-cultural study by the Rorschach Technique).

P. C. RAY, Calcutta.

In the year 1956, the author conducted a psychocultural survey among the Bhunia Baiga inhabiting the hills and forest of Dindori Tehsil in Madhya Pradesh.

The purpose of this paper is to find out by applying the Rorschach technique, the effect of culture-contact on the personality structure of the Baiga. As the problem stands, it is necessary to take into account the following considerations : (1) The samples (229 subjects were tested) should be of same origin but of varying levels of culture contact, (2) The cultural and psychological base lines should be established and (3) The Rorschach test should be administered under similar conditions.

It has been observed that a considerable shift in psychological orientation towards more social living has taken place among the most acculturated group and it may probably be due to acculturated culture-contact condition, which is taking place among them. However, it has also been noticed that the psychological adaptation of the Baiga group as a whole is more or less towards least acculturation.

16. City and Civilisation : A Study of the Sacred Complex of Gaya as a part of Indian Civilisation.

L. P. VIDYARTHI, Ranchi.

The present paper, methodological in nature, aims at bringing out the study of a sacred city (Gaya, a place of Hindu pilgrimage) as a part of Indian civilisation. The city of Gaya and its place in Hindu traditions are described in terms of three analytic concepts : a sacred geography, a set of sacred performances, and a corps of sacred specialists-features which together constitute a sacred complex. In the analysis of this sacred complex of Gaya the process of continuity, compromise and combination between "great and little" traditions, or universal and local traditions have been discerned. In course of the analysis of the Sacred complex of Gaya, it has been established that though it is a local grouping of sacred centres, performances and specialists, it is the intricate interdependence, both culturally and structurally, with the whole breadth of Hindu civilisation. In Redfield framework, the Gaya complex is predominantly great traditional in its content, but it

incorporates, and in the past it has both incorporated and transformed centres, elements of performances, and specialists of little traditional origin. It has been also shown how Gaya has played an integrating role in Hindu civilisation by providing a traditional meeting place of different kinds of peoples and traditions, of castes and sects, of classes and statuses, and by communicating with every corner of India through texts and through priestly relationships.

The study of a famous place of Hindu pilgrimage such as Gaya, thus, can serve as a means to gain understanding of the structure and characteristic processes of Hindu civilisation. It is suggested further that by the use of such descriptive and analytic concepts, as have been developed here, may assist understanding in future study of other sacred complex in India.

SOCIAL ORGANISATION

17. Comparative Study of the Kinship systems of six matrilineal tribes.

BHABANANDA MUKHERJEE, Calcutta.

An attempt is made here to study the kinship systems of two sets of tribes following residence of unidentical nature and practising different marriage rules. Application of the structural principles and the criteria employed for calculating potential categories of relatives, has been employed, besides testing of a particular hypothesis of Murdock on the criterion of affinity. For the purpose of classification of the different systems into a particular type, the schemes of Kirchoff, Lowie and Murdock have been followed.

As the work is being pursued and to be extended to other kinship systems of patrilineal tribes, tentative conclusions based on the primary findings are given below :—

- (1) All the kinship systems of the matrilineal tribes conform to particular types—Seneca and Iroquois.
- (2) Residence has no specific role in the categorization of relatives.
- (3) Correspondences between terminology and similar marriage practices are not uniform.

18. The Migration myth of a Luguru clan.

U. R. MHIRIWEELS, Madras.

The Luguru tribe is composed of several clans, which migrated from the south, whilst the Mwenda clan of this tribe came from a country in the north, described to suggest northern Kenya.

Such a derivation of the clan may throw new light on the bilineal succession pattern and the use of term *lukolo* among the Wa-Luguru.

19. Distinctive Attitudes of Single and Joint Families on Planned Parenthood.

U. GUHA, Calcutta.

This was a part of a study carried out among women of a few castes in several U.P. villages and women of a Calcutta Muslim bustee. 102 women belonged to single families and 126 to joint families. The findings are as follows :—

1. Women of joint families had less objection in having more babies than women of single families.

2. Women of joint families wanted to bear their last children earlier. Otherwise society ridicules them if they became pregnant simultaneously with younger generations. Women of single families wanted to become a little older and maturer before having children.
3. Women of joint families did not mind so much the shorter spacing between babies because there were older and experienced women to take care of children. Women of single families wanted longer spacing as there were no other women in their families to look after children.
4. More women of joint families were unwilling to limit families. Bulk of the unwilling women of single families thought it sin to interfere with natural laws.
5. Most women of joint families willing to limit babies, left it to the elders to devise ways and means. Most of the women of single families, on the other hand demanded active co-operation from husbands.
6. The rate of abortion increased after the third and the fifth births with single and joint families respectively.

It was concluded that due to the distinctive family patterns, the attitude of the two types of families differed, women of joint families being more passive and women of single families being more active. It was thought advisable to convert the elders in joint families before approaching young couples.

RELIGION

20. Lodha Spirit-doctors and their Spells.

P. K. BHOWMICK, Calcutta.

The Lodhas, an excriminal tribe of West Bengal, appreciate the value of spells in avoiding difficulties and dangers in their normal daily life. They have specialists like spirit-doctors who deal with these unseen powers of different grades in supernatural world. Thus the ghosts or other evil forces are driven out by means of magical blow as well as clear uttering of long winded spells. In the same way, to depoisn a man a spirit-doctor performs elaborate ceremony uttering spells in melodious tone. They have firm faith over the spells and the spirit-doctors. Failure is attributed to defects in performing ceremonies and wrong pronunciation of spells. It is important to note here that in these spells there are mentioning of names of different Hindu deities like Saraswati, Parvati and Manasa and sacred places like Puri etc. indicating gradual contact with the Hindu world.

Details of these have been discussed by the writer in this paper.

21. Clan ossuaries of the Bhumij of the Pargannah of Barabhum.

HIMENDRA NATH BANERJEE, Calcutta.

The Bhumij of the Pargannah of Barabhum (within the former district of Manbhum) like some other Mundari tribes such as the Ho, Munda, etc., have clan ossuaries or burial places. They are considered as an eastern off-shoot of the Munda of Ranchi District since early nineteenth century. Due to continuous contact with the neighbouring Hindus, they have adopted many cultural traits including the language of the latter group. Even then a few critical traditional traits like the burying of charred bones of the deceased or of the corps itself in clan-ossuaries, are tenaciously retained by them. These ossuaries are strictly restricted to their respective clan-members. People living nearby or at distant places bring the charred

bones or the corpse of their agnatic kins to their respective clan-ossuaries and bury the same in the particular lineage-line or *panta* to which it belongs. An attempt has been made in this paper to know, the lines of migration of different clan-groups, the nature of distribution of all the clans, the feeding area of the different ossuaries, Hindu influences on the religious beliefs and practices of the Bhumi etc. from a study of some of the clan-ossuaries of the Pargannah of Barabhum.

22. Velichapad.

M. S. GOPALAKRISHNAN, Madras.

In Kerala, the worship of the Goddess, Bhagavati is seen almost in every village. The *Velichapad* is a shaman attached to every Bhagavati temple, and his role in the performance of ritualistic rites during festivals for the goddess is institutionalised. In the worship of *Sasta* and in that of *Naga* also the *Velichapad* is present, but his behaviour and dress differ from that we see during Bhagavati worship. In a state of possession the *Velichapad* gives out words which we cannot easily understand, and these are supposed to prophesy about the future. At one time the *Velichapad* may have been a priest of the goddess.

23. The Disposal of the Dead : From Exposure to Cremation.

K. V. KRISHNA AYYAR, Ramnagar.

Archeology has been able to recover in a remarkable way the history of the dead past. Of all the monuments unearthed by it the houses of the dead give more information than the houses of the living.

The Tamil epic, *Manimekhalai*, mentions five methods of the disposal of the dead; which may be logically reduced to three, exposure, burial, and cremation, the first leading to the second and the second to the third.

The anthropological interpretation of archaeological data is difficult for two reasons: the survival of the old customs among the new, and the danger of affirming the consequent.

On apriori groups exposure must be regarded as the earliest method of disposing of the dead. Affection and respect for the dead lead to burial as the best method of protecting the dead body against the carrion eaters.

The same feelings and the belief that the dead helped the living when necessary lead to their burial within sight, as among the Nayadis, and under the floors of houses as among the Amorites and the Egyptian Badari. The Maski graves in the habitation are point in the same direction.

The funeral customs of the Nayadis explain what is obscure. At first they buried within sight. When the dead increased in number, the burials had to be made further and further away; but at the end of the year after the exarnation of the bones, these were housed in the *Manram* the common place of worship as well as the meeting place of the village elders. When the *Manram* became too small, the exarnated bones were buried in a convenient spot, and the dead were housed in the *Manram* by a representative stone. Most of the burials discovered south of Brahmagiri are secondary burials.

The posture in which the dead was buried at first influenced by tenderness, later by considerations of convenience. The erect burial of Onega is the grave of a chief and is the proverbial exception proving the rule.

The orientation of graves was similar to the orientation of houses east-to-west; the presence of north-to-south graves in Maski represents the Aryan immigrants.

The principle underlying the funerary furniture and accompaniments in the grave of the Nayadis and those in the graves of kings and chiefs is the same : what the dead had been accustomed to or derived comfort from, while alive. The idea underlying the housing of the dead by the representative stone of the Nayadi and the housing of chiefs under menhirs and in elaborate cists is also identical.

Cremation creeps in when it is not possible for some reason or other to keep the grave intact sufficiently long to allow exhumation by natural processes. Prolonged war and aggression were mainly responsible for this practice. The idea that the dead live in a world of their own and their happiness is promoted by the severance of all ties with this world still further worked for cremation.

Living in isolated and scattered houses, in the midst of extensive forests or gardens, the Namputiri Brahmin of Kerala could dispose of his dead in his own land but with the help of non-Brahmins -a practice found nowhere else.

24. Shamanism amongst the Lodhas of West Bengal.

P. K. BHOWMICK, Calcutta.

Shamans are not uncommon in the Lodha society. They are the persons who get the special favour of the deities like *Silala*, *Manasa*, *Chandi* and the like. Shamans are requested by the villagers to know the causes of calamities or mishaps of an individual or community members. They are also requested to state the necessary method of propitiation, sacrifice etc. in order to prevent all these incidents. They establish direct communication with the supernatural world. Queer feats associated with violent shaking of hands and body are the outer signs of spirit possession. At this state various questions are asked to the Shaman, then he becomes an "Oracle". Repeated offering of incense smoke or several strokes of sacred whip from the shrine to the shaman's spasmodic body by the village priest and offering of water etc. bring the shaman to conscious stage. Detailed investigations in this respect specially about the activities and training pattern of the shaman have been discussed in this paper.

LANGUAGE

25. Some evidence of affinities of Dravidian Languages with the Semitic and Scythian groups.

RAMCHANDRA RAO, Bangalore.

During past periods of sojourn in Iraq (1919-1920) and Baluchistan (1931-1933), the writer had observed a certain striking resemblance between certain Arabic and Brahui words and their analogues in the Dravidian languages of South India. Consequently, he had been devoting part of his spare time to a comparative study of the vocabulary of these languages since then. As a result, a glossarial list of comparable synonyms in these languages was prepared. As Caldwell (1856) had, in his "Comparative Grammar of the Dravidian Languages", already made a glossarial study of these tongues in comparison with Semitic and Scythian languages, relevant additions to the list were made in regard to the Semitic and Scythian groups. Over 70 words have been listed up for purposes of study, which include personal pronouns, substantives, adjectives and verbs. A cursory study of the glossary has in many instances shown evidence of real affinity between the Dravidian languages and some of the Semitic and Scythian groups, in contra-distinction to those of the Indo-Aryan group. Since according to Hutton (*Census of India*,

1931, Vol. I, Part I), the origin of the Dravidian races is traceable to a Mediterranean stock, which had, in successive migrations, moved into India from the direction of Asia Minor by the 4th Millennium B.C., it is apparent that the affinities observable in the glossary are not a matter of mere fancy.

LAW

26. Ri Seng or Land of Cognates among the War Khasi.

PRANAB KUMAR DAS GUPTA, Calcutta.

The War Khasi who inhabit the southern part of Khasi and Jaintia Hills of Assam, are one of the sub-groups of the Khasi tribe. They build a non-exogamous social-grouping, the 'Seng' or a cognatic group, members of which are held together by a tie of common ancestry which entitles joint ownership to an ancestral land. The common land round which this social-group is built up is known as 'Ri Seng' or land of the 'Seng'.

Among the War Khasi clan is matrilineal, i.e., children are affiliated to their mother's clan. The affiliation to the 'Seng' is only recognised in the matter of land ownership and is traced whether through father or mother due to the system of inheritance which entitles children of both sexes to inherit parental property. The two principles of recognition of kin which are functioning in the social organisation of the War Khasi, one directing the descent in female line in the matter of clan affiliation and the other through male and female lines in the matter of inheritance, are of special importance.

A comparative study on other common land-holdings among the Khasi, the Munda, the Abor, the Lhota Naga, the Maori of New Zealand and land tenure in Wogeo, one of the Schouten Islands situated off the northern coast of New Guinea, has been attempted.

APPLIED ANTHROPOLOGY

27. Field Approach to the Recreational life of Man.

M. N. BASU, Calcutta.

Man has never lived and even today he does not live by bread alone. He is not content with a humdrum existence. He craves entertainment in the form of recreation. He has invented many of his past times for his deep urge for recreation. The technique of collection of data in the field on different recreational aspects like games, dances, music, folk-lore and arts of man, is discussed.

28. Application of Anthropology to Administration : Case studies in a rural and a tribal area.

GOURANGA CHATTOPADHYAY, Calcutta.

This note is presented here essentially with the idea of initiating discussions on various topics falling within the realm of applied (social) anthropology, a sphere to which so far much attention has not been paid on the platform of the Indian Science Congress Association.

With the help of two case studies of traditional village councils—one in an area inhabited by the Hos (Seraikella) and the other in a village in West Bengal (Midnapur District), the possible rôle of anthropologists in the forming of the official Panchayats has been discussed.

MUSEOLOGY

29. Injurious conditions for the preservation of Ethnological specimens in Museums.

M. N. BASU, Calcutta.

Various injurious conditions for the preservation of ethnographical specimens in museums—light, moisture, atmospheric condition, dust and dirt, insects and bacteria and their remedial measures, are discussed.

SECTION OF MEDICAL & VETERINARY SCIENCES

President :—DR. A. R. NATARAJAN, B.Sc., M.B.B.S. &
D.E.L., M.Sc. (Lond.), D.I.C., F.R.I.C. (Eng.)

Abstracts

BACTERIOLOGY

1. Studies on relative bacteriophage—sensitivity of *V. Cholerae* and El Tor vibrios.

S. MUKERJEE, Calcutta.

El Tor vibrios closely resemble *V. cholerae* but are differentiated from cholera vibrios by their ability to lyse sheep or goat erythrocytes in Greig test. Haemolytic properties may be acquired by lysogenised *V. cholerae*, while this property in El Tor vibrios may be retarded and therefore overlooked. Due to variable results obtained in haemolytic tests using different methods it has been thought unwise to lay too much weight on this test.

Cholera bacteriophages are anti-O phages. On account of similarity of O antigens of *V. cholerae* and El Tor vibrios the cholera phages may be expected to have same lytic range on El Tor vibrios as on *V. cholerae*. In the present studies it has been found that group I and III cholera phages could lyse most of the El Tor vibrios. But, while a group IV cholera bacteriophage in routine test dilution produced confluent lysis of each of 1549 strains of *V. cholerae* it failed to lyse any of the 43 recently isolated pathogenic El Tor vibrios from Celebis Island and 7 non-pathogenic El Tor vibrios from water sources in Calcutta.

Lysability to this group of phage may, therefore, prove to be a confirmatory test to differentiate the two vibrios.

2. Studies on Leptospirosis amongst goat in India. I. Isolation of an incomplete biotype of *Leptospira pomona*.

P. G. PANDI and P. C. SEKARIAN, Izatnagar.

Leptospira pomona (strain G₆) was isolated by direct culture and through guinea pig inoculation from the liver as well as the renal tissue of a goat, showing general symptoms of lack of appetite, fever, intensive jaundice and excretion of dark red or brown urine for seven days before slaughter at the local abattoir at Naini Tal. The strain was peculiar in that it could not absorb completely the agglutinins from a standard antiserum against *L. pomona*. This appears to be the first record of an incomplete biotype with *L. pomona*, though such a phenomenon was noted earlier with *L. icterohaemorrhagiae*, *L. autumnalis*, *L. ballum* and *L. australis*.

The blood serum agglutinated the strain up to a dilution of 1:1000. The agglutination titre of the urine was 1:160. No agglutinins were found against *L. icterohaemorrhagiae*, *L. canicola*, *L. grippotyphosa*, *L. hebdomadis*, *L. sejroe* and *L. hyos*. However, a titre of 1:300 was obtained with *L. autumnalis*.

Serological evidence of infection was found in 9 out of a total of 42 goats examined so far. It is interesting that only one out of 36 samples of sera of sheep

showed a titre of 1 : 300 with *L. pomona* but no titre against the seven serotypes included in this survey.

The relationship of caprine leptospirosis to human and animal infection with *L. pomona* is discussed.

3. Effect of displacement of air cell on hatchability of eggs.

H. P. TANDON, K. K. AGARWAL and S. BOSI, Izatnagar.

The position of the air cell is an important consideration in the incubation of eggs as from the 18th day onward the embryo's beak breaks into the air cell and preliminary respiration begins. Normal position of the embryo at hatching time is with the head in the broad end of the egg and beak buried under the right wing. Therefore if the air cell is situated away from the beak of the embryo suffocation will lead to the death of the embryo. In the present experiment the side surface of the egg in its longitudinal axis was divided into 3 equal parts which were numbered in descending order from 1 to 3 beginning from the broad end. It has been observed that eggs having air cells in their upper $\frac{1}{3}$ (towards the broad end, hatch as well as those eggs having normal air cell in central position on the broad end of the eggs. The position and size of the air cell on the 18th day of incubation in all these eggs was practically the same. When the air cell was located in positions 2 and 3, the hatchability came down to 57.1 and 25% respectively. Fertility, in eggs having floating air cell, was very poor (51.2%) and hatchability zero i.e. no egg floating in air cell hatched.

4. A preliminary study in a new type of Infectious Hepatitis in ducks.

P. G. PANDE, S. B. V. RAO and B. R. GUPTA, Izatnagar

A new type of hepatitis in ducks, which exists in acute, sub-acute and chronic forms, caused by a virus has been recorded. The tempo of mortality is slow but affects persistently all age groups from two weeks to one year, particularly hatchery ducklings up to twelve weeks of age. Nervous symptoms like incoordination of movements and torticollis in young birds, and "going light" due to anaemia in adults characterise the disease. The syndromes produced by the virus though somewhat similar to Duck Virus Hepatitis (D.V.H., a disease known since 1950) differs in some aspects as organs other than livers are affected. A filterable agent has been isolated by chick-embryo culture and produces lesions in chick and duck embryos different from DVH. virus. The serum-neutralization tests, both in embryos and ducklings have proved the virus isolated to be antigenically unrelated to D.V.H. virus. As the nature of the disease seems to be egg-borne (but has not been proved) the findings may have far reaching economic importance to the duck raising provinces in India.

5. Enteritis of ducklings caused by an organism belonging to (*Shigella*) *Alkalescens*—*Dispar* group.

B. R. GUPTA and S. B. V. Rao, Izatnagar.

An outbreak of enteritis in 2 to 5 week old ducklings due to (*Shigella*) *Alkalescens*-*Dispar* group of enteric organisms is recorded.

The organism was isolated regularly from the intestines of dead and ailing ducklings. Older birds were refractory to the disease while acting as carriers.

The "carriers" were eliminated by rapid whole blood agglutination test, and the flock was shifted to more sanitary pens. The rest of the birds were vaccinated against the disease with a vaccine prepared from the isolate, where upon the mortality ceased. The organism was typed as belonging to (*Shigella*) *Alkalescens* Dispar group, which was confirmed by the Central Veterinary Laboratory, Weybridge Surrey, England. It proved pathogenic to rabbit causing necrotic enteritis, and to chickens. This is the first recorded case in India of an A-D group organism of the *Enterobacteriaceae*, affecting poultry, which is usually pathogenic to human beings.

6. Some recent isolations and typing of *Salmonella* organisms in chickens.

B. R. GUPTA and S. B. V. RAO, Izatnagar.

Two outbreaks of paratyphoid infections have been recorded in chickens in two large poultry farms.

The first outbreak was of more serious nature and caused 43 per cent mortality in two to three weeks old chickens. Two types of *Salmonella* organisms viz. *Sal. concord* ('O'=6, 7; H=lv-1, 2.) and *Sal. newport* ('O'=6, 8; H=eh-1, 2.) were isolated separately from different chickens, in the same outbreak. The morphological, biochemical and cultural characters of both the organisms were similar, but serologically they could be classified as separate types.

The second outbreak was of a sub-acute type causing sporadic but persistent deaths in two to six weeks old chicks and was due to *Sal. typhimurium* O=4, 5, 12; H=i-1, 2. Arthritis affecting tibiotarsal joints was observed in some of the birds.

Sal. newport and *Sal. typhimurium* are notorious for *Salmonella* food poisoning in human beings and hence they are of great public health importance.

7. Immunological studies on *Pasteurella septica*. V. Further observations on the immunising efficacy of adjuvant vaccine.

M. R. DHANDA, J. M. LALL and P. C. SEKARIAH, Mukteswar-Kumaon.

The previous studies with the oil-adjuvant vaccine showed that this vaccine induced solid immunity in hill cattle against experimental infection for as long as a period of 12 months. The results of further investigations recorded in this paper demonstrated convincingly that the duration of immunity conferred by this vaccine was at least 2 years. Work on the development of immunity revealed the interesting finding that a good grade of resistance to artificial challenge was set up as early as 5 to 7 days, indicating that the vaccine would be effective even when used in the face of an outbreak. Tests on its keeping quality showed that it did not deteriorate in its protective properties for at least 2 years when stored in the dark at room temperature ranging from 2.2°C to 29.5°C.

Extensive studies on the antibody response in vaccinated cattle by several indirect methods including the newly adapted haemagglutination and lytic tests as well as the highly sensitive PCA reaction in guinea pigs showed that antibodies appeared as early as 3 to 4 days and persisted as long as 752 days. There was significant correlation between antifracton IB antibody titre and the immune status as ascertained by direct challenge. Antitoxin levels of sera appeared to be reliable indicators of natural or artificial exposure to *P. septica*. The significance of these findings in relation to control of haemorrhagic septicaemia is discussed.

8. Duration of immunity in fowls following vaccination with freeze dried Ranikhet (Newcastle) disease vaccine.

P. R. NILAKANTAN, SAKKUBAI P. RAMACHANDRAN and M. R. DHANDA,
Mukteswar-Kumaon.

Two hundred and thirteen fowls varying in age from $2\frac{1}{2}$ to $3\frac{1}{2}$ years were challenged with 10,000 infective doses of a virulent strain of RD virus. These were the culled fowls from a poultry farm and were immunized when 6 to 8 weeks of age with freeze dried Mukteswar (R_2B) strain of the virus. Whereas 207 of the birds proved solidly immune, six birds succumbed to challenge infection.

The birds were bled before challenge and their sera were subjected to haemagglutinin-inhibition test. 131 (64.53%) had a HI titre of 80 and above, 49 (24.14%)—20 to 40 and 23 (11.33%)—10 or less while sera were not available for test from ten birds. Of the six birds that died of challenge infection five did not reveal the presence of any HI antibody and one had a titre of 10.

Further, when sera from 519 birds of $1\frac{1}{2}$ to $3\frac{1}{2}$ years of age of the farm were subjected to HI test, it was observed that 305 (58.77%) had a titre of 80 or above, 135 (26.05%) 20 to 40 and 70 (15.22%) 10 or less.

The results revealed that the freeze dried Mukteswar strain of RD virus gave satisfactory immunity practically throughout the useful span of life of fowls.

9. Haemagglutinin-inhibiting and neutralizing antibodies in the protein fractions of plasma of fowls immunized with Ranikhet (Newcastle) disease virus.

P. R. NILAKANTAN, S. S. NEGI, SAKKUBAI P. RAMACHANDRAN and
and M. R. DHANDA, Mukteswar-Kumaon.

Studies were conducted to ascertain the distribution of antibodies in the various protein fractions of plasma of fowls subsequent to immunization with Mukteswar (R_2B) strain of Ranikhet disease virus. The protein fractions of the plasma, viz., fibrin, euglobulin, pseudoglobulin I and pseudoglobulin II were obtained by precipitation with step by step increasing concentration of sodium sulphite.

None of the protein fractions of plasma obtained from unimmunized birds revealed any haemagglutinin-inhibiting (HI) activity. Two weeks after immunization the titres of the fibrin, euglobulin and pseudoglobulin I, in HI units per mg. of protein, were 445, 890 and III, respectively. In another set of experiments, the pseudoglobulin II fraction also contained demonstrable but very low amount of HI antibodies. It appeared that the HI antibodies may not be detectable in solutions below a certain concentration.

Neutralization tests carried out in embryonating eggs with various protein fractions obtained from fowls at two weeks post vaccination showed that the neutralizing doses of fibrin, euglobulin and pseudoglobulin I fractions each containing equivalent amounts of protein, were 5×10^4 , 5×10^5 and 5×10^3 respectively, while the embryo infective titre of the virus in the presence of euglobulin obtained from unvaccinated birds was 2×10^4 .

10. Observations on the haemagglutinin-inhibition reaction of sera of fowls immunized with four different strains of Ranikhet (Newcastle) disease virus.

P. R. NILAKANTAN, SAKKUBAI P. RAMACHANDRAN and M. R. DHANDA,
Mokteswar-Kumaon.

Groups of fowls were immunized with Mukteswar, Palestine, 'B₁' and 'F' strains of RD virus. Sera obtained from these fowls at varying periods after immuniza-

tion were subjected to HI test against the homologous as well as the heterologous strains of the virus. Beta test employing two IIA units of virus as constant factor was adopted throughout.

Whereas all the four strains of RD virus in question were immunologically identical, in that, the birds immunized with any of the strains resisted challenge with a virulent strain of the virus, certain differences in HI titre was evident when sera were tested against heterologous strains. In all instances HI titres of sera were higher when Mukteswar strain was used as antigen than when other strains were used and the Palestine strain was next in the order. 'B₁' and 'F' strains resembled each other and gave a low HI titre when tested against either homologous or heterologous immune sera.

BIOCHEMISTRY

11. Effect of thyroid and vitamin A & E on seminal composition of infrared irradiated and cryptorchid guineapigs.

A. K. CHOWDHURY and P. B. SEN, Calcutta.

The seminal composition of guineapigs made bilaterally cryptorchid or both the testes exposed to infrared irradiation was studied at different intervals after the operation. The influence of thyroxine, methyl thiouracil and vitamin A & E mixture was also studied on these animals. It was found that infrared irradiations caused a gradual depression of activity of the secondary sex organs resulting in serious damage of these organs. Methyl thiouracil also caused considerable depression but cryptorchidism did not produce such depression. Treatment with thyroxine or vitamin A and E mixture caused an increased activity of these organs as reflected from the total amount of ejaculate collected and its composition. The nitrogen, ascorbic acid and activities of the phosphatases, both acid and alkaline were analysed in all the sample after 6, 12 and 19 days interval from the day of operation. Semen was obtained by applying a 30 volt alternating current on the heads for a few seconds.

12. Thyroid function test using low doses of I¹³¹-HSA.

SUBHAS R. BASU and FAZLE HOSAIN, Calcutta

Several cases of hyper-, eu- and hypo-thyroid cases have been tested for their thyroid function using only 1-5 μ c of I¹³¹-labelled human serum albumin against the conventional use of 10-100 μ c of NaI¹³¹. The method is based on the determination of the ratio of the activities of the saliva to protein-bound iodine at the 24th hour of the ingestion of the tracer isotope. The assay of the radioactivity was made using a windowless gas-flow GM counter operated in anticoincidence with a ring of GM counters. The saliva to PBI ratio ranged between 0.3-0.6, 1.3-15 and 21-46 for three hyper-thyroid, eight normal and four hypo-thyroid cases respectively.

13. Studies on the utilization of vitamin A. Part IV. Influence of the level of protein on the storage and utilization of vitamin A.

G. C. ESH and S. BHATTACHARYA, Calcutta.

High prevalence of xerophthalmia and other eye signs attributed to vitamin A deficiency in children suffering from kwashiorkor and other protein malnutrition

states have been observed by many workers in recent years. To what extent protein deficiency may affect the metabolism of vitamin A is not known. A series of investigations are in progress regarding the influence of protein nutrition on various aspects of the metabolism of vitamin A and carotene with a view to finding out their mutual interrelationship. This paper reports the influence of the level of protein (6%, 12% and 18%) in the diet on the storage and utilization of vitamin A fed at two levels 50 I.U and 710 I.U per day during both maintenance and protein regeneration state in adult rats.

The results indicate that during maintenance highest liver storage of vitamin A is observed at 12% protein intake with lower dose of vitamin A. With massive dose of vitamin A, however, highest storage is found in animals receiving diet with 18% protein. But in case of protein deficient animals the liver storage seems to be lower with higher level of protein intake. With the above condition of vitamin A feeding highest protein utilization is observed at 12% protein in the diet. A slightly greater weight gain results when massive doses of vitamin A are fed at all levels of protein intake. The results as a whole indicate that the level of protein in the diet has considerable effect on the storage and utilization of vitamin A.

14. Comparative efficiencies of different levels of groundnut cake in growing and laying poultry rations.

S. BOSE and K. K. AGARWAL, Izatnagar.

Studies have been made to determine the comparative efficiencies of different levels of ground nut cake ranging from 10 to 50 per cent of the growing and laying rations. The approximately protein percentage of the various groups ranged from 19 to 28 per cent in growing rations and 15.4 to 21.4 in laying rations. The results of the experiment indicate that ground nut cake can be included in growing and laying rations at a level of 50 per cent and 30 per cent respectively without any detrimental effect in growth and egg production. The present investigation also shows that growing chickens and laying hens can tolerate fairly high protein rations if other conditions are favourable. As the relative prices of cereal and ground nut cake favour the increased use of groundnut cake for economic poultry ration, it should be used liberally in poultry production, replacing much of the expensive cereals which are used as carbohydrate supplements. This is important because the development of poultry industry should not compete with the human needs for cereal grains.

15. Studies on Cataract.

KALYAN BAGCHI, Calcutta.

The etiology of cataract is far from clear. A considerable amount of work has been done in recent years on this problem by physiologists, biochemists, clinicians, nutritionists, ophthalmologists and also workers from various diverse fields. The biochemical pattern of the lens has attracted special attention of these workers. The sulphhydryl compounds of the lens has assumed a position of great importance due to its close association with the biochemical reactions in the lens and also for the fact that its concentration is greatly affected by the clinical condition of the lens. Recent research has shown that this group of compounds in the lens is closely correlated with the protein content of the diet. A low protein diet and an extreme form of methionine deficiency produced by methionine sulfoximine administration produces great reduction in the SH group in the lens followed by

mature cataract. In the present investigation, the glycolytic process in the lens was studied under different conditions. There was a significant decrease in the lactic acid and glucose content of the lens as a result of a low protein diet. When incubated in vitro in a nutrient fluid, the glucose consumption of these lenses were much lower than those obtained with the lens from control animals. Similarly the lactic acid formation fell much below the normal level. These findings indicate that as a result of a low protein diet, the glycolytic process in the lens which is the main metabolic path of this tissue falls below the normal level. This can possibly be explained by the fact that the enzymatic activity of the lens has been decreased due to the reduction of the protein bound sulphhydryl group. Methionine deficiency produced by the administration of methionine sulfoximine in rats results in mature cataract. It results in serious biochemical lesion in the lens whereby the carbohydrate metabolism is greatly affected. This derangement of carbohydrate metabolism might be the cause of damage of the lens which ultimately produces cataract.

PATHOLOGY

16. Studies in Carcinoma of the Esophagus.

S KRISHNAMURTHI, Madras.

1. Fifty-six cases of carcinoma of the esophagus were analysed and classified according to site. The pathology, the histology and etiology are discussed.
2. Thirty-seven cases were accepted for radio-therapy and one for surgical resection. Of the 37 cases twenty-nine received super-voltage therapy.
3. All the 37 cases were in a fairly advanced stage of the disease, the radiological length of most lesions exceeding six cms.
4. Of the 56 cases 7% had mediastinal involvement, 12.5% had distant lymph nodal involvement, 14.3% has distant metastases and 7% had squamous cell carcinoma of the mouth also.
5. Of the 37 cases subjected to radio-therapy 62.5% were radio-responsive, better response being obtained in the upper esophagus than in the lower.
6. The longest survival so far has been nearly two years in our series.
7. Surgical resection seems to be the treatment of choice in the lower thoracic esophagus and radio-therapy in the upper esophagus.
8. The Radiation Morbidities met with are outlined.
9. The importance of avoiding ineffective exploratory thoracotomies which tend to disseminate the disease is stressed.
10. It is firmly believed that a better co-ordinated surgical and radio-therapeutic attack on the disease and earlier diagnosis would improve results.

17. A few observations on the delayed somatic effects of radiation among the exposed population of Hiroshima.

T. GHOSE, Bombay.

Recently it has been possible to have more accurate estimates about the dose of the different ionising radiations to which the atomic bomb survivors in Hiroshima were exposed. Gamma and neutron doses with errors by factors of 1.5 and 2 respectively have been estimated. Previous reports on leukaemia incidence among the exposed 6 survivors were based on ill defined populations. Incidence of leukaemia based on a closed population of 74,100 exposed survivors is presented.

All types of leukaemia except the chronic lymphatic and the histiomonocytic types show increased incidence, but the increased incidence of chronic granulocytic leukaemia is most outstanding. This increase in leukaemia incidence reached its peak in 1951 and 1952 and now shows a decline without reaching the level of spontaneous leukaemia. From clinical and pathological aspects, there is no significant difference between the "radiation induced" and spontaneous leukaemias. Considering a section of this population with uniform shielding, a linear dose—response relation is obtained up to a level of about 75 rep. Some investigations show an increased tendency in this population towards the development of malignant tumours. People exposed to residual radiation only do not manifest any detectable delayed somatic effect.

18. Studies on Mastitis—I. Incidence with special reference to its Epizootology.

M. S. SETHI and M. R. DHANDA, Mukteswar-Kumaon.

Incidence of mastitis in India has been studied and the various factor e.g. breed, age, injury, season etc. which might influence it have also been examined. In brief, the observations were as follows :—

Incidence of mastitis in the different breeds of cows viz., Tharparkar, Sahiwal, Thari, Hissar, Red Sindhi, European-cross-bred, Hill and Afghan did not appear to be significantly different and that the incidence in the same breed varied considerably under the influence of environmental factors.

Incidence went on increasing with a corresponding increase in the number of lactations and that the lowest incidence was among the cows belonging to the first lactation i.e., the youngest age group and the highest amongst the highest age group.

It was observed that the incidence of clinical type of mastitis did not vary significantly during a certain period of the year. However, there was some evidence as brought out by the history sheets of the animals at different farms and also as narrated by the diaryman, handling these animals, on the basis of their experience, that the number of clinical-cases was more often calving. 'Summer mastitis' as observed in England mainly affects dry cows but in India under infections due to the various organisms appeared to occur mainly in lactating cows irrespective of season, climate or weather.

A conclusive evidence has been brought out to the effect that injury was not of much importance in the majority of mastitis cases although gross injury, when it occurred, was obviously of significance.

It was seen that the disease occurred mainly in a chronic form. Clinical cases in cows occurred only to the extent of 3.9% while the percentage of mild chronic cases was as high as 43.6%. The incidence in buffaloes was comparatively low i.e. 20.7%.

An observation was also made with regard to the occurring of 'Blind teats' as a result of mastitis. Their frequency in cows and buffaloes in the heads subjected to this study was found to be 7.2 and 7.5 per cent respectively.

19. A study of their vitro susceptibility of organisms associated with bovine mastitis.

M. R. DHANDA, S. N. BAKSHI and M. S. SETHI, Mukteswar-Kumaon.

In vitro susceptibility of mastitis organisms comprising of 14 strains of *Str. agalactiae*, 5 strains of *Str. uberis*, 10 strains of *Str. dysgalactiae*, 3 strains of *Str. pyogenes*, 12 strains of staphylococci, 1 strain of *Pseudomonas pyocyaneae* and 5 strains of *Corynebacterium pyogenes* to different antibiotics as well as combination

of drugs was studied. These organisms had been isolated from suspected cases of mastitis at the different dairy farms located in the different parts of the country. The antibiotics or combination of drugs employed in this study were (1) procaine penicillin G, (2) dihydro-streptomycin, (3) aureomycin, (4) combination of procaine penicillin G, dihydrostreptomycin and sodium sulphamezathine, and (5) combination of procaine penicillin G, dihydrostreptomycin, sodium sulphamezathine and cobalt sulphate.

A considerable amount of variation was noticed in the susceptibility of the various strains of different species of mastitis organisms to the action of the different antibiotics alone or in combination with other drugs. *Pseudomonas pyocyaneae* proved to be the most resistant to the action of all the antibiotics. There was no relationship between the susceptibility of an organism to antibiotic and its properties of producing haemolysin and coagulase and formation of a pigment. The combination of dihydrostreptomycin and sulphamezathine with penicillin showed a synergistic effect and the addition of cobalt sulphate in traces further increased the efficacy of this mixture quite considerably.

20. Bovine mastitis due to yeasts.

M. R. DHANDA, D. NANJIA and M. S. SETHI, Mukteswar-Kumaon.

A case of acute bovine mastitis due to pathogenic yeast like organism, which did not respond to treatment either with sulpha drugs or with antibiotics like penicillin and streptomycin, was encountered.

The organism responsible for infection was Gram-positive, oval, reproduced by budding and grew practically on all media. The growth which was porcelain white developed within 24 hours. It produced acid and gas from glucose, sucrose, maltose, trehalose, mannose, xylose, galactose and fructose.

The infection was noticed in a cow in its first lactation without any previous history of mastitis.

The organism was established as potentially pathogenic for the udder tissue on artificial inoculation and the infection appeared to be self-limiting as was evident from the culturing of milk samples at intervals from the mastitis case and four artificial infected goats as well as two artificially infected cows.

21. Studies on Mastitis. II. Diagnosis.

M. S. SETHI and M. R. DHANDA, Mukteswar-Kumaon.

This is a report of the work carried out to study the efficacy of various indirect tests employed for the diagnosis of mastitis for application in the field as compared with the more reliable cultural method of diagnosis. In this connection 490 quarters or quarter samples from 125 cows not showing any clinical signs of the disease were subjected to this study.

The tests taken up for the study were (1) physical examination of the udder, (2) Strip-cup, (3) Bromocresol purple, (4) Bromothymol blue (5) White-side, (6) chloride, (7) catalase, (8) leucocytic count, (9) lotis, (10) direct microscopic examination of milk and (11) direct microscopic examination of gravity cream, each with an accuracy of 70.2, 62.4, 50.6, 44.6, 70.3, 77.1, 66.1, 84.9, 66.9, 46.1 and 73.1 per cent respectively. The study of bromocresol purple and bromothymol blue tests was, however, confined only to 242 samples of 53 cows as these tests being less reliable were not included in the subsequent comparative trials.

The merits and demerits of these tests have been discussed and the relative efficacy of each in the diagnosis of mastitis has been brought out.

22. Pattern of leukaemia in Indians. I. Incidence of different types.

J. B. CHATTERJEA and SANDHYA GHOSH, Calcutta.

A series of 307 cases of leukaemia were investigated to study the incidence of various types. The series included 51 children.

Acute leukaemia accounted for 50.2%, chronic leukaemia for 45.3% and sub-acute leukaemia for 4.5% of the total number of cases.

In children, acute leukaemia was by far the commoner, constituting 92.1% of total number of cases. Acute lymphocytic leukaemia (43.1%) was the commonest type, followed by myeloid (31.4%) monocytic (11.8%) and undifferentiated (5.9%), in that order.

In adults, chronic leukaemia constituted 53.1% of cases. In the chronic group, myeloid leukaemia (44.2%) was by far the commonest, followed by lymphocytic (6.6%) and plasmocytic (2.3%) in that order. In the acute group, myeloid (18.4%) was again the commonest type, followed in order by lymphocytic (12.1%), monocytic (10.5%) and undifferentiated (0.8%).

PHARMACOLOGY

23. Antihistamine activity of Quinoline Thiazolidine compounds.

J. K. MOHANTY, B. N. DAS and P. TRIPATHY, Cuttack.

Eleven compounds which contain fused thiazole and quinoline rings were screened for antihistaminic and antiacetylcholine activities using various biological preparations. Only three compounds of the series were found to have such action to a significant degree. Of these three compounds, M87-BP (Code number) seems to be the most potent. Its antihistaminic action seems to be more than antiacetylcholine action. Results of relative potency studies indicate that as an histamine antagonist, it is more powerful than antazoline hydrochloride (Antistine), under the experimental conditions described. As an anticholinergic it is very much feebler than oxyphenonium (Antrenyl), a drug widely used in clinical practice.

24. Preliminary observation on the amoebicidal action of *Tylophora indic* and *Pæderia foetida*.

N. K. ROY and B. K. BOSE, Calcutta.

A number of plants growing abundantly in a state of nature in many parts of India, are being used for a long time in the treatment of dysentery. But the pharmacological investigations of many have not yet been thoroughly done. *Tylophora indica* (Burin. f.) Merr. (Antri, Sans.) and *Pæderia foetida*, Linn., (Prasarani, Sans.; Gandal, Beng.) are among those which are extensively used in indigenous and folk medicines. The former was recommended as an antidysenteric drug as a substitute for Ipecacuanha by Roxburgh, Russel, Anderson, Fleming, Kirkpatrick and others, and it was included in Bengal Pharmacopoeia in 1844 and in Pharmacopoeia of India in 1868. Considering that investigations on these plants may be of economic importance work was taken up in this laboratory since a pretty long time. In in-vivo tests in our inbred laboratory mice and rats and in in-vitro tests in modified Ishii and Kutsumi's medium using a strain of EH 502 developed in this laboratory, it has been observed that *T. indica* (succus) has got definite amoebi-

cidal activity both in-vivo and in-vitro in a dose level 0.1 c.c. per 10 gm. body weight and 1 in 1,000 dilution respectively. But on the other hand, *P. foetida* failed to show any amoebicidal action both in-vivo and in-vitro, though slight temporary inhibitory action was noticed. Any relief produced by the drug is likely to be due to inhibition or suppression of other intestinal pathogenic flora. Further work is being continued for separation of the active constituents and comparative evaluation vis-a-vis other amoebicidal agents.

25. Preliminary report on experimental phacoanaphylaxis with human cataract lens material.

K. N. OJHA and M. C. Misra, Cuttack.

Phacoanaphylaxis is reported as one of the complications of the extra-capsular extraction operation.

The present work was undertaken to study if the antihistaminic drugs could prevent the occurrence of the experimentally induced eye reactions to lens material in animals.

The rabbits were mostly used for this study. Into the eyes of the rabbits suspensions of lens material prepared aseptically were induced intra-ocularly into the anterior chamber. This method caused a series of eye reactions from mild to severe or very marked degree. 1.5 to 2.0 ml of normal saline was used per lens to prepare the suspension. With 24 size fine needle and 0.5 ml tuberculin syringe 0.1 ml of the lens suspension was delivered into the anterior chamber. As a control separate groups of rabbits were injected with sterile normal saline and sterile fine suspension of starch. The control group did not show the usual eye reactions.

On repeating the second injection of the lens material suspension into the anterior chamber of the previously sensitized eyes caused always very marked reactions in these eyes.

Synopen instilled into the eyes or given intramuscularly in the dosage of 0.1 ml of 1% solution given daily did not prevent the occurrence of the eye reactions.

PHARMACY

26. Bromometric estimation of Methocarbamol.

P. M. PARIKH and S. P. MUKHERJI, Bombay.

Methocarbamol or 3-(0-Methoxy phenoxy)-2-hydroxy-propyl carbamate was found to form bromoderivatives. Optimum conditions under which this property can be exploited for developing a quantitative estimation of methocarbamol have been presented.

Methocarbamol dissolved in alcohol and diluted with water is reacted at 0° with the excess of bromate bromide solution and dilute hydrochloric acid. At the end of 10 minutes excess of bromine is estimated in the usual manner by sodium thio-sulphate. From the quantity of bromine consumed, content of methocarbamol is calculated.

The common excipients and lubricants used in manufacture of tablet of methocarbamol do not interfere. The method can be used for estimation of methocarbamol in pure state and in tablets, in which form, this drug is usually administered.

PHYSIOLOGY (VETERINARY)**27. Effect of vitamin B¹² and antibiotics on hematopoiesis in the chick.**

H. C. SAXENA and K. KUMAR, Udaipur.

The effect of vitamin B₁₂ and penicillin on hematopoiesis in the chick was studied. Deficiency of vitamin B₁₂ resulted in retardation of growth as well as in a lower blood content of hemoglobin, erythrocyte and hematocrit. When vitamin B₁₂ deficiency was aggravated by an anaemia resulting from injection of phenylhydrazine HCl, vitamin B₁₂ was shown to have a stimulatory action on hematopoiesis. A single injection of phenylhydrazine HCl into 6 week old chicks caused anaemia and a seven day period elapsed before hemoglobin, erythrocyte and hematocrit values of deficient chicks reached a normal level whereas only five days were required for vitamin B₁₂ supplemented chicks to return to normal hematological levels.

28. Blood picture of Kankrej cows and calves.

B. M. PATEL, G. F. MITTAL and B. G. SHAH, Anand.

Morphological constituents were determined in the blood of (a) 15 calves below 1 year, (b) 16 calves between 1 and 2 years, (c) 46 cows between 3 and 7 years and (d) 14 cows between 8 and 16 years. In order to observe the effect of pregnancy, the data on 25 pregnant cows were compared with those of 35 nonpregnant ones.

It has been observed that young calves up to 2 years of age as compared to cows from 3 to 16 years of age have a significantly higher amount of :

Erythrocytes—8.92 millions per ml. as against 6.75; Leucocytes—13.58 thousands per ml. as against 11.61; Packed cell volume—40.06% as against 36.09%; Mean corpuscular haemoglobin concentration—34.99% as against 30.94%; Lymphocytes—48.35% as against 34.20%.

However, their mean corpuscular haemoglobin was lower : 15.23 $\gamma\gamma$ as against 18.21 $\gamma\gamma$ and eosinophils 6.52% as against 9.50%.

Pregnant cows, as compared to empty ones have a significantly higher amount of :

Haemoglobin in gms % 13.1 as against 11.9; Mean corpuscular haemoglobin - 20.40 $\gamma\gamma$ as against 19.46 $\gamma\gamma$; Eosinophil—10% as against 9%.

29. A method for the identification of rapid feathering character in day-old chickens.

R. B. L. SRIVASTAVA and S. BOSE, Izatnagar.

The rapid feathering trait in chicks is of great economic importance as the rapid feathering chicks are better protected against chilling and are heavier at broiler age than the ones with slow feathering. In broiler industry the rapid feathering chicks are preferred because they are well feathered as compared to the late feathering individuals who look naked or pin feathered in backs. Investigation has been carried out to find out an easy method to identify the rapid and slow feathering chicks suitable for the poultry farmer in India, by examining the secondary feathers at hatching time. It has been observed that all those chicks which show six or above number of secondary feathers are rapid feathering whereas chicks showing 2, 1 and 0 secondary feathers, are slow feathering individuals. Chicks

showing 3, 4 and 5 number of secondary feathers on the hatching day are doubtful cases and should be re-examined on the tenth day for tail feathers. Those showing tails on tenth day are rapid feathering chicks and individuals without tails are slow feathering.

30. Day old sexing in cross bred chicks.

H. P. TANDON and S. BOSH, Izatnagar.

Day-old sexing of chicks is an important item on farms engaged in producing egg laying stocks. The vent method of day-old sexing is a specialized job. With the increase in the production of cross-bred poultry for commercial purposes it will be advantageous to make use of sex-linked inheritance for sexing baby chicks.

During the present study efforts have been made to sex cross-bred day-old chicks on the basis of the sex-linked slow and rapid feathering character. The progeny of White Leghorn males crossed with Rhode Island Red and Barred Plymouth Rock females could be sexed at day-old with 94 per cent accuracy. Chicks having remiges bigger than their respective coverts were classified as rapid feathering (females) and those having remiges smaller than the coverts were grouped as slow feathering (males).

31. The inhibitory effect of Colchicine on gastric secretion in group cannulated pigeons.

K. N. OJHA, Cuttack.

Crops cannulated pigeons were found very suitable for the study of the effects of colchicine on gastric secretion. The drug reduces the volume and acidity of the gastric juice produced in response to histamine as reported by Koskowaski and Mahfouz (1953).*

In the present series of experiments different method was used so that no anaesthesia is used at the time of obtaining the gastric secretion in response to histamine and acute operation of opening the abdomen, as followed by previous workers, was avoided. Colchicine was given in the dosages of 0.1, 0.15 and 0.2 mg/100 gm for 3 to 6 days.

It was observed that while dose of 0.1 mg/100 gm did not produce significant effects, colchicine in the dose of 0.2 mg/100 gm proved to be toxic as mortality was frequent when this dose was used. Significant reduction of gastric juice and free HCl secreted in response to 0.02 mg per 100 gm histamine was produced when colchicine in the dosages of 0.15 mg/100 gm was given intramuscularly daily for 6 days. It was also observed that all the pigeons, given colchicine treatment, showed loss in their weight.

In four pigeons gastric secretory response was studied before and after the colchicine treatment. The gastric secretory response was obtained with the fixed dose of histamine every time. It was observed that there was reversal to normal gastric secretory response after an interval of 6 to 12 days.

* J. Pharmacol. & Expt. Therap. 109, 361, 1953.

32. Economic testing and recording of milch cattle for their production.

R. N. DESAI and M. D. SHARMA, Mathura.

The monthly yields estimated on the basis of once a month testing of milch animals, vary between 1.34 to 8.00 per cent for milk and -1.2 to 5.1 per cent for fat test in cows and 4.5 to +7.0 for milk and -1.5 to 10.0 per cent for fat test in buffalo. The estimates for the whole lactation period for milk vary only within 1% of the actual both in case of cows and buffaloes.

The cost of testing milk samples once a fortnight and once a month comes to 32 n.P. and 16 n.P. respectively for every animals. The labour in recording the performance would also be reduced proportionately to 1/15th and 1/30th respectively of that involved in daily recording. This strongly suggests that testing of cows could be economically and accurately applied to rural as well as farm cattle to estimate their production and thus create more room for further employment in the rural areas.

33. Milk with egg-yolk as diluter for Haryana bull semen.

G. N. CHAURASIA and S. K. SAHA, Mathura.

Egg-yolk with milk in the proportion of 1 : 2 and 1 : 3 can be used for the preservation of cow bull semen. Both the diluters are equally good in which the semen of Haryana bull can be kept preserved for insemination purpose for an average period of 5.10 days in Y_1M_2 (Egg-yolk 1 part and milk 2 parts), 5.30 days in Y_1M_3 (Egg-yolk 1 part and milk 3 parts) and 3.0 days in milk.

Since non-electrolyte diluters yield better results than those with electrolytes, milk and glycine diluters have proved better. In this diluter a complete elimination of the use of the electrolytes for buffering capacity has yielded promising results. Egg-yolk with milk proved more efficacious in respect of half life (insemination level) over that of milk diluter alone. Secondly milk and egg-yolk being biological substances are easily available and the process of preparing the diluter is simple and practicable under the field condition as it avoids the need of accuracy in weighing the chemical buffers. Thirdly the chemical salts when stored for long periods may undergo change in their water of crystallization resulting in inaccurate osmotic pressure of the buffer when used as semen diluter.

The fertility trials of these diluters are in progress.

33A. Studies on heritability and genetic correlation of some characters of economic importance—II : (i) Interval between first two calvings, (ii) Yield of milk in the second lactation.H. V. DADLANI, S. V. CHANDIRAMANI and P. BHATTACHARYA,
Izatnagar.

Records of 74 dam-daughter pairs involving 10 sires in the Haryana breeding herd at the Indian Veterinary Research Institute, Izatnagar, were studied, in respect to the first calving interval and yield of milk in the second lactation.

Mean, its S.E. and coefficient of variation for calving interval in these dams and their daughters were : 427.24 days and 461.00 days, 9.69 days and 16.00 days, and 19.52% and 29.85% respectively. Similar statistical values in respect to milk yield were : 3218.23 lb. and 2578.78 lb., 156.90 lb. and 130.30 lb., and 41.94% and 43.47% respectively.

Heritability coefficient was low ($+0.0184 \pm 0.448$) for calving interval, but rather high ($+0.4300 \pm 0.226$) for milk yield. Little improvement was, therefore, expected from further selection for calving interval, but the expectation for milk yield was rather good.

Phenotypic and genetic correlations between the calving interval and milk yield were $+0.1572$ and $+0.1870$ respectively.

Positive genetic correlation between calving interval and milk yield indicated that the breeding in the past had been guided by selection for both these traits. These correlations help in establishing a selection index for a breeding herd.

STATISTICS

34. An estimate of the food cost of maintenance and milk production of India's cows and she-buffaloes in terms of nutritive standards and money values (A preliminary study). 1. On the basis of India as a whole.

I. CHATTERJEE and S. SAHA,

This study shows that on the basis of India as a whole the maintenance share of food cost (103.14 lakh tons of T.D.N. worth 363 crores) for milking cows alone is 3.4 times the food cost (30.34 lakh tons of T.D.N. worth 106.76 crores) required for producing milk. This ratio high as it is becomes 8.5 times on overall basis of all cows (18.953 m. milkers and 28.581 m. non-milkers) involving 258.7 lakh tons T.D.N. worth 909.8 crores, raising the total cost to 1015.55 crores.

In the case of buffaloes the maintenance cost (79.9 lakh tons T.D.N. worth 281.02 crores) for milkers is 1.8 times the cost of milk production; and the overall maintenance cost (166.66 lakh tons T.D.N. worth 586.08 crores) for milkers and non-milkers comprising 21.304 m. is 3.72 times.

The cost for maintenance and milk production of cows and buffaloes together involve 500.58 lakh tons T.D.N. worth 1760.34 crores (1495.87 crores for maintenance and 264.47 crores for milk production). Out of 1495.87 crores maintenance cost, non-milkers swallow 85%.

When the estimated money return from milk viz., 986.5 crores (364.6 crores or 37% from cows and 621.9 crores or 63% from buffaloes) is deducted from food cost (1760.34 crores) it shows a loss of 773.85 crores. Of this huge loss cows account for 84% and buffaloes 16%.

The sum-total of the effect is that while the production of cow and buffalo milk is worth 987 crores the huge maintenance cost of large number of unthrifty animals is involving the country into an annual loss of 774 crores equivalent to 6 to 7 times of what we are annually spending in importing food grains. In a good many States (discussed in the next paper) the position is considerably worse.

35. An estimate of the food cost of maintenance and milk production of India's cows and she-buffaloes in terms of nutritive standards and money values (A preliminary study). 2. On the basis of Regions and States.

I. CHATTERJEE and S. SAHA,

In India's critical food situation a protective food like milk is in still shorter supply. In some 15 States the per capita availability is not only below the tentatively fixed standard of 10 oz., but in Orissa and West Bengal it is less than half and in Assam and Kerala it is less than one-fourth. Himachal Pradesh, Punjab, PEPSU, Saurashtra and Rajasthan have over 10 oz., availability. In the rest it is

between 1.29 and 7.07 oz. The lowest yield rate per cow in Madhya Pradesh and Vindhya Pradesh is 1/22 ind. of Punjab and 1/118th of Denmark. Neither the yield rate nor the total production of food grains presents such a wide variation.

One important reason for low milk production from cows is that despite their colossal number, non-milking cows outnumber the cows in many States by $1\frac{1}{2}$ to over three times. In India it is 1.6 times. Punjab, PEPSU, Saurashtra, Delhi, Bombay and Himachal Pradesh are favourably placed in this respect. Male oxen required for cultivation also outnumber the cows (1.2 times in India). In the case of she-buffaloes their number is 2.6 times of male buffaloes.

In States like Vindhya Pradesh, Bombay, Madhya Pradesh, and Assam the maintenance cost of *milking cows alone* is 9 to 15 times the cost of milk production. In the remaining States it is between 1.44 times in Punjab and 4.68 times in Jammu and Kashmir. On the basis of both milkers and non-milkers the ratio jumps up to 26.6 in Assam, 25.8 in Madhya Pradesh, 25.7 in Vindhya Pradesh, 21.8 in Bombay, 15.9 in Hyderabad, 15.1 in Orissa, 14.7 in Mysore, 12.8 in Jammu and Kashmir and 11.4 in Madhya Bharat. In the rest it fluctuates between 2.5 in the Punjab to 8.9 in Madras.

In the case of she-buffaloes the maintenance cost of milking animals only in Punjab is even less viz., 0.9 times of cost of milk production. In the majority of States it varies between 1.16 in Saurashtra to 2.78 in Bombay. Only in Madhya Pradesh it is 3.46 and in Assam 5.78. On the basis of both milkers and non-milkers the ratio varies from 1.66 in the Punjab to 7.00 in Madhya Pradesh and Vindhya Pradesh. Only in Assam it is 12.83.

Thus, while neither cows nor buffaloes have been economic, the position of cows has been still worse. Some related aspects have also been discussed.

SECTION OF AGRICULTURAL SCIENCES

President :—DR. B. N. SINGH, Ph.D., D.Sc.

Abstracts

AGRONOMY

1. **Studies on nutrition of oilseed crops. III. Interaction of phosphorus and sulphur on growth, yield and oil content of mustard (*Brassica juncea* Hook F. & Thoms.).**

P. K. SEN and P. SENGUPTA, Calcutta.

Results of a sand culture experiment on the effects of increasing levels of phosphorus deficiency and of addition of correspondingly increasing doses of sulphur to make up for ionic disbalance in the phosphorus deficient nutrient solutions on growth, yield and oilcontent of mustard (Var. Rai P-85) are presented. Height, number of branches and leaves, flowering period, fruit set, development of seed and oilcontent are adversely affected by phosphorus deficiency. Addition of sulphur to phosphorus deficiency conditions has no beneficial effect.

2. **Seasonal effect on growth, time of floral initiation and emergence of earhead in *Aus* and *Aman* rice (*Oryza sativa* Linn.).**

P. K. SEN and N. ROY, Calcutta.

An investigation into vegetative growth, floral initiation and emergence of earheads in two *aman* (Patnai 23 and Bhasamanik) and two *aus* (Dhairal and Charnack) varieties of rice, sown on four photoperiodically important dates, has been carried out.

The *aman* varieties have in general shown longer duration, greater height, larger number of tillers and larger number of leaves than the *aus* varieties in all the sowings except in the sowing in September. The time taken for floral initiation is significantly longer in the *aman* varieties than in the case of *aus* varieties in all the sowings, except in the sowing in June, when the two *aus* varieties and one *aman* variety (Patnai 23) have taken equal time for floral initiation. The time taken by the other *aman* variety (Bhasamanik) is also significantly shortened in this sowing in comparison to other sowings of the same variety.

The time-lag between floral initiation and earhead emergence is significantly longer in *aman* than in the *aus* varieties in all the sowings except in the sowing in September.

Floral initiation is not confined to short day or long day periods either in *aus* or in *aman* varieties but earhead emergence in *aman* varieteis has generally been limited to short day period, whereas in *aus* varieties emergence of earhead has taken place both in short day and long day periods.

3. The effect of manure on the yield, economy and nutritive value of pasture grass.

I. CHATTERJEE, Calcutta.

The experiment was conducted for one manurial year and three residual years on a land with undisturbed natural herbage for 30 years. Eight treatments and one control were randomly distributed in six blocks having 54 1/57 acre individual plots. The treatments gave a green yield from 269 mds/acre to 328 md/acre or 137% to 167% on 100 of control during manurial year, and 201 mds/acre to 317 mds/acre (124% to 197% on 100 of control) during two residual years. The three years' mean annual yield from the eight manurial plots (taking them all alike) gave 268.24 mds/acre green yield equivalent to 112.7 mds/acre dry matter. It works out at 102 lbs. green forage (51 lbs. dry matter) per day during six months between May and October. On 8 lbs. basis of dry matter it means daily provision for 6.4 animals or for a total of 1,160 animals of 400 lbs. live weight.

The return per rupee on lowest cost of treatment (Rs. 20.00 per acre) was 13.75 mds. (4.05 mds of dry matter).

The estimated annual yield of T.D.N. and digestible protein showed high economic advantage when considered on the basis of same amount of T.D.N. and D.P. present in oilcakes.

The results show that pasture grass is the cheapest means of supplying food for our cattle.

4. Nutritive values of straws from pure rice straws.

I. CHATTERJEE, Calcutta.

This work was conducted with straws from Departmentally evolved pure rice strains (12 from Kharif *aus* variety and 9 from winter *aman* variety). The analysis of *aus* samples, when compared with "Kataktara" variety as the standard, showed a variation of +20 to -65% in protein content, +10 to -103% in ether extract and +16 to -41% in soluble ash content. In the case of *aman* samples, comparison with "Indrasail" variety of Chinsura as standard, showed a variation ranging from +11 to -76% in protein content, +31 to -29% in ether extract, +6 to -132% in soda content, +41 to -27% in potash content, +36 to -1286% in chloride content, +7 to +56% in phosphorous content, +5 to -27% in calcium content and +4 to +54% in oxalic acid content. Indrasail variety grown in Chinsura alluvial soil showed 2.372% as compared to 1.235% oxalic acid when grown in Dacca red soil. An unspecified variety of *aman* straw from the saline tracts of Barisal recorded negligibly low percentage (0.039% oxalic acid). There was also large variation in some of the nutritive components in the different straws.

The feeding and metabolic tests were conducted with *aman* varieties of Indrasail, Latisail and Bhasamanik. Both Indrasail and Latisail had similar composition except that Indrasail contained more total and digestible protein and ether extract; and the ingestion of other components from it was slightly more. The animals under the feeding of Indrasail straw definitely fared better.

5. Preliminary study on the effect of application of phosphoric acid on yield and oil content of groundnut.

R. N. MOHANTY and G. C. DUTTA, Bhubaneswar.

The variety A.H. 477 (erect variety) was taken for the experiment. The treatments consisted of (1) Control (No P_2O_5), (2) 20 lbs. of P_2O_5 , (3) 40 lbs. of P_2O_5 ,

(4) 60 lbs. of P_2O_5 and (5) 80 lbs. of P_2O_5 per acre, applied in one dose at the time of sowing. The experiment was laid out in randomised block design, with three replicatoin. As the plant population was low the observations were recorded on five single plants selected at random, from each of the above treatment, in each replication. The yield per plant was statistically analysed and was not significant. There was an improvement in the size of pods due to application of phosphoric acid. The oil content of seeds, as analysed by soxhlets methods showed a trend of gradual increase with the increase in the dose of phosphoric acid applied to the crop.

6. Response of sugarcane varieties to nitrogen doses.

A. R. KHAN and K. S. BASAPPA, New Delhi.

The results of an investigation, to assess the relative merits of six new cane varieties viz., CO. 797, CO. 647, CO. 659, CO. 1109, CO. 999 and CO. 998 manured at four levels of nitrogen—0, 40, 80 and 120 lbs. N per acre have been presented in this paper. Varieties exhibited significant differences in respect of cane yield as well as commercial cane sugar. Variety CO. 1109 registered the highest yield of 878.17 mds. of cane per acre and was at par with CO. 647 (799.24 mds. per acre) but significantly superior to the rest of the varieties. There was progressive and significant increase in the yield of cane with increase in the levels of nitrogen from 713.66 mds. in 'control' treatment to 795.75 mds. in the N3 treatment. The optimum level of manuring was observed to be 80 lbs. per acre under the soil and cultural conditions of this experiment. The interaction between varieties and nitrogen was not found to be significant.

7. Preliminary study on the effect of nitrogen fertilizers on growth and yield of spring (Boro) paddy.

B. N. GHOSH, Chinsurah.

Manurial trial was conducted in randomised blocks with four replications to study the effect of two types of nitrogen, organic (mustard cake) and inorganic (ammonium sulphate), singly and in combination, applied at the rate of 100 lb. per acre during final puddling, on growth and yield of boro paddy, variety Chinsurah boro-1.

Both organic and inorganic manures, when applied singly and in combination, gave definitely higher yield of grain and straw over the "no manure" treatment, the increase being the greatest with organic manure in combination with inorganic manure. The percentage increase of grain and straw under mustard cake, ammonium sulphate and in combination (mustard cake plus ammonium sulphate) is 27.5, 16.7 and 28.0 for grain and 17.3, 18.1 and 29.1 for straw, respectively, over no manure. Grain yield data are not significant, while the data for straw are significant at 5% level.

Height of the plant, length and breadth of the flag are found significantly higher in the manured plots, the response being the greatest with ammonium sulphate, while no significant difference in the number of total and ear-bearing tillers and in the ear-length is recorded. Slight early flowering is noticed in the control plants, which is statistically significant at 5% level.

8. Influence of climatic factors on growth and yield of spring (Boro) and summer (Aus) paddy.

B. N. GHOSH, Chinsurah.

Seven varieties of boro paddy, Assam—I, Assam—II, Assam—IV, D. I.—3, D. I.—4, Kakuria and Chinsurah boro—1, and three varieties of aus paddy, Dhairai, Marichbutti and Bhutmuri, were sown in both kharif and boro seasons. The experiment was conducted for two consecutive years in randomised blocks with six replications.

During initial stage, a significant difference in the tillers among the varieties is noticed in kharif and boro season. Low temperature in January and February during boro season checks the rate of tiller formation, while higher temperature in July and August during kharif increases the rate. During boro season plant growth in height continues.

Greater plant height and flag leaf's length and breadth are recorded during kharif season in both the years, when there is high temperature, high percentage of relative humidity and heavy rainfall.

Khar emergence begins, irrespective of boro and aus varieties, when the day length is over 12 hours.

Chinsurah boro—1 and Bhutmuri, though belong to boro and aus group respectively, behave well in both the seasons in respect of their grain yield, while boro varieties, D. I.—3, D. I.—4 and Kakuria are very sensitive to climatic conditions. Their grain yield was very poor during kharif season, when they contributed mostly towards straw. Two aus varieties, Dhairai and Marichbutti, are unsuitable for cultivation during boro season.

9. Studies on the formulation of manurial schedule of sugarcane crop in relation to phosphate absorption through foliage analysis. Part II.—Effect of different doses of phosphate in soils in relation to its absorption by sugarcane crop.

J. C. BHARGAVA and S. C. SEN, Kanpur.

An experiment with CO. 453 was laid out with 4 different doses of phosphates viz. 50, 100, 150, 200 lbs. per acre. The phosphate was applied as double superphosphate. The periodic sample of the 4th leaf from four mother canes of four different treatments were removed and separately analysed for P_2O_5 content.

The analysis of variance of all these four different treatments during August to November at an interval of 21 days showed non significant values confirming that more than 50 lbs. P_2O_5 per acre has no beneficial advantage.

10. Role of subsoil water in alkali soil formation.

R. S. MURTHY and T. B. RAUT, New Delhi.

Soil survey in Uttar Pradesh has shown that the watertable is generally high (48-72 inches) and there is considerable fluctuation in the subsoil water level between the wet and dry periods of the year. The high watertable and the bad quality of water have been responsible to bring about salinity, and alkali hazards in soils and thereby rendering them useless for cultivation. Soil analysis has revealed that pH of the twice saturation paste is very high (8.35 to 10.15). The Electrical Conductivity of twice saturation extracts is extremely high ranging between 30 and 180 mmhos/cm. water soluble salts comprise predominantly of carbonates among an ions and sodium among cations. The exchangeable sodium per cent varies from 35 to 80. Water analysis has shown that the pH is very high,

9.5; Electrical Conductivity is 2.1 mmhos/cm. Carbonates and bicarbonates are present in appreciable amounts (12.84 and 5.17 m.e./litre). Sodium content is very high (19.46 m.e./litre) when compared to total calcium+magnesium. It is thus seen that the nature and quantity of salts present in the soil depends to a large extent upon the nature and quantity of salts present in the ground water.

11. Kurai or Sink-hole soils.

K. V. S. SATYANARAYANA and N. K. SHENDE, New Delhi.

In the course of a reconnaissance soil survey of the National Extension Service Block, Sohawal, Satna district, Madhya Pradesh, it has been noticed that the land surface is marked by small scale undulations, in a net like pattern, appearing like 'sink-holes'. These are locally called 'Kurai'. The 'Kurai' are very well developed in the 'regur' type of soils of pasture lands and less so in the cultivated areas. The sink-holes are circular, oval or irregular in shape. They lie in the general direction of the slope of the land at 8 to 10 ft. distances and their size depends upon the depth of the parent rock. They are verticle where the parent material is near to the surface while they are slanting where the parent material is deep and in some cases ends into the fissures of the underlying rock as embedded in a matrix of yellowish gray lime concretions and clay. In contrast to normal soils the clay content is more and colour is a shade darker. The iron and lime concretions are also low.

12. Reclamation of saline and alkali soils in semi arid and arid regions under restricted irrigation facilities.

R. K. CHIBBER and K. V. S. SATYANARAYANA, New Delhi.

In semi-arid and arid regions salinity is usually an ever present hazard. There are areas where neither the supply of water is adequate nor is it of good quality to leach out salts, replace sodium (soil alkali) by calcium salts. In Delhi State where the annual rain fall is about 25 inches and most of it is received in the monsoon period, it was thought to utilize rain water for leaching out the salt. Generally the soils are of lighter texture and moisture retention capacity is low. The treatments given to soils are (a) control, (b) gypsum at 2 tons per acre, (c) organic manure at 4 tons per acre and (d) gypsum plus organic manure. Puddling of the soils after the first heavy shower made the water standing for a very long long time on the plots and replacement of sodium by calcium in the exchange complex was possible and is confirmed by the pH measurements of soil. In gypsum treated plots the pH value has come down from 9.0 to 8.0. In the rabi season the plots were sown to wheat; the treatments increased yields more than 100% over control in case of gypsum organic manure. These experiments have demonstrated that vast areas of dry saline and alkali lands can be brought under cultivation.

13. Effect of different levels and forms of phosphate fertilizers on the yield of rice crop.

I. C. MAHAPATRA and B. N. SAHU, Bhubaneswar.

The treatment combinations consisted of four forms of phosphatic fertilizers, (bone meal, rock phosphate, superphosphate and hyper phosphate) \times 2 levels of P_2O_5 (20 lb. and 40 lb.) per acre+2 controls (one unmanured and the other with 20 lb. of N as sulphate of ammonia). The experiment was conducted for three years at the same site with three replications. A basal dressing of 20 lb. N per

acre in the form of ammonium sulphate was applied to all the plots except the unmanured control. A long duration variety of paddy, BAM. 6 (160 days duration) was used in the experiment.

The results indicate that there is no marked difference among various forms and doses of phosphatic fertilizers tried in the experiment though the control yield was significantly lower than the average effect of the manured treatments. The response to P_2O_5 is lower than that of ammonium sulphate at equal P_2O_5 and N levels. Best returns are indicated for a combination of 20 lb. N and 20 lb. P_2O_5 . Bone meal gives best response. A combination of 20 lb. P_2O_5 in the form of bone meal and 20-40 lb. of N in the form of ammonium sulphate, is found to be the most profitable dose for maintaining fertility.

14. Increased food production by proper utilization of irrigation waters by the determination of water requirements of crops.

A. P. BHATTACHARYYA, Roorkee.

The importance of the determination of water requirements of crops in the economy of a country has been explained. It is already known that when less (than the correct requirement) water is applied the production of crops is lowered. But it is not so well known that when more (than the correct requirement) water is applied, the production is also lowered and the quality of the crop suffers. Due to an ignorance or non-application of this phase of water requirements of crops, the Indian cultivator is wasting valuable irrigation waters by over-irrigation and the production is being lowered. In other words, proper use is not being made of the available water supplies to the detriment of the country's economy. It has been estimated that the loss suffered by India on this score is of the order of Rs. 40 crores. Hence the importance of the subject.

The technique of the determination of water requirements of crops has been explained in a previous paper of the author, "Irrigation and Water Requirements of Principal Crops in U.P." presented at 1957 Session of the Indian Science Congress.

15. Preliminary observations on the effect of intercultural operations on the yield of fibre (*C. olitorius*—var. JRO—632) in a line sown jute.

B. K. DAS, S. MITRA and S. PALCHOWDHURY, Barrackpore.

A trial in replicated randomized layout was conducted for two years. The treatments included no hand weeding, one hand weeding and two hand weedings with or without thinning of plants followed by 4 or 6 wheel hoeings. In addition four treatments receiving only one or two raking across the lines followed by 4 or 6 wheel hoeings were also included.

The treatment differences were significant in the individual years as well as in pulled analysis. In the serial analysis of the 2 years data, the highest yield was obtained from the treatment receiving 2 hand weedings plus 2 thinnings plus 4 wheel hoeing (20.31 mds./acre) closely followed by the treatment receiving 2 hand weedings plus 2 thinnings plus 6 wheel hoeings (19.09 mds./acre). Four other treatments viz., (a+b) one weeding plus one thinning with 6 or 4 wheel hoeings (16.97 and 16.79 mds./acre), (c) 2 weedings plus 2 thinnings only (16.45 mds./acre) and (d) 2 thinnings plus 6 wheel hoeings (16.19 md./acre) also gave sufficient high yield. Two hand weedings followed by 4 wheel hoeings are quite sufficient for getting better yield of fibre during normal seasons. For any one particular year, when labour is very acute one may go even without hand weeding but may thin-out the plants in two instalments and give 6 wheel hoeings which would enable him to get sufficient high yield.

16. Feed value of some concentrates in Gujarat.

B. M. PATEL, P. S. PATEL and B. G. SHAH, Anand.

A study on the composition and nutritive value of some of the common concentrates in Gujarat was undertaken. The concentrates studied were *bajri* grains (*Pennisetum typhloideum*), cottonseeds, cottonseed cake, groundnut cake, guar seeds (*Cyamopsis psoralirides*) and *tur* seeds (*Cajanus indicus*).

The D. P. and T. D. N. per 100 lb. of dry matter were as follows :

	<i>Bajri</i>	Cotton seeds	Cotton seed cake	G. N. Cake	<i>Gaur</i>	<i>Tur</i>
D.P.	4.45	14.09	15.55	37.80	22.23	17.11
T.D.N.	70.86	67.22	57.70	72.00	69.82	77.70

The nitrogen, calcium and phosphorous balances are also given.

17. Composition and yield of pasture grasses in Saurashtra as affected by different methods of harvest.

B. M. PATEL, B. G. SHAH and P. S. PATEL, Anand.

A study on the yield and composition of pasture grasses in Saurashtra was undertaken in collaboration with Dr. F. W. Albertson, T.C.M. Grassland Specialist. In the reserved grasslands at Hirasar and Valadhari grasses were harvested by four different methods, each from a plot of 12' x 8'. There were six replicates for each methods at every place.

The results indicated that when the grasses are harvested at monthly intervals the N.P.E. increases with decrease in crude fibre in successive cuttings. In the second and third method the first cuts at two and three months' growth respectively are inferior to the subsequent monthly cuttings especially in crude protein. On the whole, as the grasses mature the crude protein content decreases from 6.02 to 1.66, phosphorus from 0.14 to 0.04 and calcium from 0.54 to 0.35 per cent, while N.P.E. increases from 42.45 to 51.60 per cent.

The total yield of fodder by four, monthly cuttings is only 1252 lb. per acre on dry basis, as compared to about 1900 lb. by (1) first cutting at two months and then every month, (2) first cutting at three months and then after a month and (3) first cutting at four months. The nutrient yield per acre computed from these data reveals that the second method of harvest is the best.

18. Nutrients in pasture grasses of Kutch.

B. M. PATEL, B. G. SHAH and V. V. MISTRY, Anand.

Thirty-two enclosures were laid at random throughout the sweet and saline regions of Banni area in Kutch. Each enclosure was divided into three compartments from which grasses were harvested at different stages of growth.

The study revealed that *Oin* (*Cressa cretica*) is the best grass in both the sweet and saline regions, though its occurrence was scanty. However, *Lamp* (*Aristida funiculata*), *Dinai* (*Dichanthium annulatum*) *Dabhado* (*Sperobolus virginicus*) and *Sonval* (*Alysicarpus rugosus*) are found to be predominating grasses in the area, which have only 2 to 6 per cent protein with fibre as high as 30-38 per cent.

The composition of pasture grasses at different stages varied in such a way that it was difficult to know the optimum stage for harvesting unless the yield data also simultaneously taken into consideration. On the basis of both these data it is evident that maximum output of nutrients would be obtained by first harvesting the grasses after about six weeks' growth and subsequently at monthly intervals.

The results thus indicate the deterioration of the quality of pasture due to overgrazing and lack of proper management.

19. Feed value of some cereal byproducts.

B. M. PATEL, P. C. SHUKLA and H. C. SAXENA, Anand.

Composition of four kinds of husks, three of brans from cereals and important byproducts like maize gluten, rice polish etc. was studied. Husks are found to be poorest byproducts containing minimum amount of protein and maximum crude fibre, whereas the brans can be classified as good feeds as they contain 10-20 per cent crude protein and are also rich in N.P.E. (65 to 75%). Wheat bran contains as high as 1.60 per cent phosphorus. Among other byproducts maize gluten is richest in crude protein (47%), maize germ oil residue is highest in ether extract (36%), polish is a rich source of phosphorus (1.6%).

Digestibility trials on *bajri* husks, maize bran and wheat bran revealed that the D.P. and T.D.N. provided by them are 2.54, 7.57, 9.29 and 58.33, 88.42, 70.42 lb. respectively. The nitrogen and mineral balances are also indicated.

20. Studies on the effect of ammonium chloride and other fertilizers on the yield and crude protein content of pearl millet (*Pennisetum typhoideum*—Rich.).

H. C. SHAH and B. V. MEHTA, Anand.

Field-experiments were conducted on sandy loam soil over a 2-year period covering 3 crop seasons. Ammonium chloride, ammonium sulphate, ammonium sulphate-nitrate, ammonium nitrate, urea, groundnut cake and farm-yard manure were used. The fertilizers were applied at two levels of fertility, i.e., 20 lb. and 40 lb. nitrogen per acre with and without phosphorous added at the rate of 40 lb. P_2O_5 per acre in the form of superphosphate.

Maximum yield of straw was produced by ammonium sulphate-nitrate, ammonium nitrate and urea, while lowest by ammonium sulphate and ammonium chloride. Organic sources gave much lower yield than the synthetic ones. Of the two levels of nitrogen, 40 lb. per acre gave significantly higher yield ($P=0.01$) than 20 lb. per acre.

There was no significant difference in the crude protein content of straw as a result of nitrogen fertilization, either alone or in combination with phosphorus. The percentage of applied nitrogen recovered in straw and in ground portion of the pearl millet plant decreased with increased nitrogen rates.

Regression analysis between yield and crude protein content of straw showed a negative correlation.

So far as yield and crude protein content of pearl millet straw are concerned, ammonium chloride is not inferior to ammonium sulphate.

21. Significances of slope and erosion in land capability classification in the Machkund catchment.

S. DIGAR and A. K. SEN, Calcutta.

The paper deals with significances of the study of the factors like slope and erosion etc. to determine the land classes according to their capacities. A sample region of 12.30 sq. miles was taken up in the Catchment area of the Machkund river of Orissa and the evolution of micro relief was traced by slope and erosion survey. Variation of effective soil depth due to different degree of erosion in different slope regions was also studied and tabulated. Data has been statistically analysed to find out the correlation co-efficient and partial correlation co-efficient between the factors. Both slope and erosion have effect on effective soil depth, but the effect of the latter is much more pronounced.

As the capability of lands in Machkund Catchment depends significantly on the variation of slope, erosion and effective depth of soil, definition of land capability classes according to size distribution of these factors has been defined. As the land capability depends mostly on slope and erosion, the paper concludes with a fuller treatment of the factors for management and conservation practices.

22. Effect of growth substances on root formation in cutting of *Justicia* (*Justicia gendarussa* Linn.) as influenced by nitrogen nutrition.

P. K. SEN and R. N. BASU, Calcutta.

The results of an experiment on the effects of IAA, IBA, NAA, and MH on root formation of leafy and leafless cuttings of *Justicia gendarussa* Linn., taken from stock plants grown in sand culture, under four different levels of nitrogen, namely, (1) balanced nitrogen—N, (2) high nitrogen—3N, (3) moderate nitrogen deficiency— $1/9$ N and (4) acute nitrogen deficiency— $1/81$ N are presented. The stock plants grown under these varying levels of nitrogen provided cuttings materials with varying C/N ratios in the order $1/9$ N $> 1/81$ N > 3 N.

Root initiation is found to be directly proportional to C/N ratio but root development is independent on a proper balance of carbohydrate and nitrogenous substances. IAA, IBA, and NAA have root promoting effects whereas MH has a root inhibitory action. Among the three root promoting substances NAA has shown the highest effect, next in order comes IBA and last IAA. The differential effects may be due to their differential capacities of stimulating hydrolysis of carbohydrates and proteins.

Leaf has a beneficial effect on root initiation only with application of root promoting substances. It has a beneficial effect on root development with or without application of root promoting substances. The beneficial effect of leaf on root development suggested to be due to its carbohydrate and protein reserves. As opposed to root formation shoot formation shows an inverse relation to C/N ratio. The root promoting effect of IAA, IBA and NAA is associated with a shoot inhibitory effect.

An increase in the number of roots per cutting due to a high C/N ratio and/or application of a growth substance is accompanied by an extension of the rooting region on a cutting.

23. Effect of 2, 4-dichlorophenoxyacetic acid on growth of rice and *Amaranthus* seedlings.

T. M. DAS and DIPAK ROY, Calcutta.

Inhibitory action of 2, 4-dichlorophenoxyacetic acid on growth of seedlings of rice, variety *Rupsail* and *Amaranthus*, variety *Viridis* increased in presence of con-

tinuous light, intensity of which was only 125 F.C. Under normal day and night the effect was less than that found under continuous treatment of light.

Treatment of seeds with 2, 4-D affected the growth of embryos, the effect was increased with the increase of concentration as well as duration of the treatment. At higher concentration of 2, 4-D, translocation of hydrolysed food materials from endosperm to the embryo decreased during germination, but when 2, 4-D was applied at later stage of growth, such inhibition of translocation was comparatively less. The effect, of 2, 4-D significantly decreased with the age of the plants. Rice seedlings in general, were found to be the more tolerant than *Amaranthus*, but at the time of germination rice embryo was more susceptible to injury than *Amaranthus*. Roots of both *Amaranthus* and rice were more affected than shoots at all stages of growth.

The seeds of both rice and *Amaranthus* were affected even if they were sown at 3" to 4" deeper layer of the soil. A noticeable inactivation of 2, 4-D was found after 15 days of its application on the soil.

24. Change of geotropic behaviour of rice coleoptile by 2,4-dichlorophenoxy-acetic acid.

T. M. DAS and DIPAK ROY, Calcutta.

Rice grains, variety *Rupsail*, after soaking in water for six hours, were allowed to grow on moist filter paper in glass jars in darkness. The filter paper was spread round the internal wall of the jar and was approximately half immersed in different concentrations of the 2,4-D solutions. A few mm. distance above the solution surface, soaked grains of rice were set in a single row and were kept at 30°C in darkness for 96 hours. Coleoptiles of rice at 10 and 100 ppm. 2,4-D solutions behaved just like roots, i.e. instead of growing upward, they pushed themselves vertically downward and exhibited distinct positive geotropism. Growth of root, however, was checked at these concentrations.

Under longer duration, the submerged coleoptiles at 10 ppm. 2,4-D solution grew extensively further downward with unsplit tapering tip and after 264 hours they were 75 mm. in length, while the control in darkness was only of 32 mm. in length with split head. It is thus revealed that the capacity for elongation of coleoptile is considerably more than what is assumed under continuous darkness. This observation may be important in relation to the application of 2,4-D in rice field during early stage of crop growth.

25. A study of a hormone treatment on Gaorani 6 and P.A.I. cottons.

M. R. H. QURESHI, Andhra Pradesh.

Acre yield of cotton in India is the lowest amongst the cotton growing countries. Pytoh hormones inhibit the shedding of buds, flowers and bolls, which is a common feature in cotton, and thereby increase the yield. A study was taken up to observe whether Gaorani 6 (*Gossypium arboreum* race *indica*) and P.A.I. (*G. hirsutum*) cottons respond to alpha naphthalene acetic acid. The hormone was applied to the plants before the commencement of flowering in a vegetative stage and at bud-formation phase in 5, 10 and 20 parts per million in single and double sprays. There were altogether seven treatments including no treatment plot. Plant height, fruit nodes, bolls per plant, shedding percentage and yield of Kapas were studied. In 5 ppm. two sprays treatment in Gaorani 6, shedding percentage was low. Number of bolls per plant were higher (4.5) bolls than the control (4.0). Yield per acre was 445 pounds, while in control it was 406. This

difference is not significant. P.A.I. treatment, 10 ppm. two sprays increased the plant height, shedding percentage was low and the yield was 309 pounds compared to control yield of 272 pounds per acre. High dose of 20 ppm. in arboreum and american cotton varieties showed adverse effect.

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26. Some techniques for evaluating nutrient status of soils.

AMBIKA SINGH, Lucknow.

Estimates of nutrient status of soils can be obtained from curves of dry matter and nutrient content of plants. The analyses and extrapolations of these curves can be performed by methods of least square and Mitscherlich-Spillman equations.

The proportion of nutrient supplied by the soil can also be estimated by use of isotopes or a substitute element and isolating the 'tagged' nutrient from the total amount absorbed by the plant.

Different forms of the response curves obtained have been discussed and method of calculating the constants of the curves have been indicated in the paper.

27. Catenary relationship in alluvial soils of Jullundar.

K. V. S. SATYANARAYANA and R. P. DHIR, New Delhi.

During the course of reconnaissance soil survey of district Jullundar, it was observed that the various soil classification units identified and mapped occurred as belts parallel to the course of the river Sutlej. This led to a detailed investigation of the relationship of the soils to the Sutlej depositional agency. The various classification units that come across a transverse from the stream to the flood-plain are: (1) Meander belt deposits, (2) Course sandy belt, (3) Sandy loam to loam belt, (4) Clay loam belt impregnated with soluble and insoluble salts and (5) Slack water clay. It is seen that size of particles decreases with distance from stream, where as soluble salt, calcium carbonate and clay content increase.

The soils occur in a catenary sequence along the slope contours. This close relationship leading to the development of the land-scape is discussed.

28. Studies on the formulation of manurial schedule of sugarcane crop in respect to phosphate absorption through foliage analysis. Part I. Determination of the particulars of the leaf to be considered for the phosphate index of sugarcane crop.

S. C. SEN and J. C. BHARGAVA, Kanpur.

To determine the temperature best suited for ashing of cane leaves for phosphate determination, the oven dried cane leaves were separately heated in the muffle furnace at different temperatures for 4-5 hours. The ash obtained by heating at different temperatures was dissolved in acid and P_2O_5 was determined. From the results it was observed that cane leaves heated between 500 and 600°C indicated consistent P_2O_5 values.

Periodical 3rd, 4th and 5th cane leaves sampled in 8 replications were collected from August to November at an interval of 21 days and P_2O_5 was determined. The coefficient of variance of these eight replications of different leaves was statistically worked out and the least coefficient of variance was found in the 4th leaf, which has been considered the best representative sample for future investigations.

29. **Studies on the formulation of manurial schedule of sugarcane crop in relation to phosphate absorption through foliage analysis. Part III. Effect of different doses of phosphate at two levels of irrigations on its rate of absorption by sugarcane crop.**

J. C. BHARGAVA and S. C. SEN, Kanpur.

An experiment was laid down with Co453 in two adjacent plots with a gap of 10 feet apart between the two blocks. Four doses of super-phosphate, at the rate of 20, 40, 60 and 80 lb. P_2O_5 per acre were applied separately. A control without any dose of P_2O_5 was also run in each block. A basal dose of N was applied to all plots in each block. Two levels of irrigations were maintained in these two blocks separately.

Sixteen irrigations were given in block I during May and June and six irrigations in block II. Periodic samples of the 4th leaf from four mother canes were taken in duplicates from all these five different treatment plots at higher level irrigation as well as at lower level of irrigation. The P_2O_5 was determined. The phosphate at the high level of irrigation was found lower in plants with phosphate than the control, whereas, lower value was found in the control than the plants with phosphates at the lower level of irrigations. All these confirm that different doses of P_2O_5 has no significant effect on either yield or quality of cane at Kanpur.

30. **Losses of nitrogen during nitrification of oil-cakes in soils and the factors affecting the phenomenon.**

V. S. KULKARNI and N. V. BHIDE, Poona.

During laboratory studies on nitrification of groundnut cake and ammonium sulphate in goradu soil considerable losses of nitrogen are reported. The effect of added materials such as molasses, calcium carbonate, excess of moisture and concentration of nitrogen on ammonification, nitrification and loss of nitrogen has been investigated. Molasses and excess moisture lower the loss of nitrogen. Molasses and calcium carbonate have depressing effect on ammonification. The lower the dose of added nitrogen, less is the loss and suggest that split application of nitrogen is more economical and is conducive to less losses. The presence of plants also reduce the loss of nitrogen. Still a considerable amount of lost nitrogen remains unaccountable, even after the uptake by plants is taken into account.

31. **Nutrient status of some red soils in Wellington (Nilgiris).**

R. S. MURTHY, New Delhi.

Top soil, generally brownish to pale brown in colour, is friable and contains sufficient organic matter. The colour changes to red or reddish brown in the lower horizons. pH ranges from 4.5 to 5.9 and increases with depth. Total soluble salt content is low and shows a decrease with depth. Clay content ranges between 31.5 and 56.3%; accumulation of clay is noticed in the 2nd and 3rd layers. Organic carbon and nitrogen contents are fairly high in the top layers (.9 and .1% respectively). The available P_2O_5 figures are high (.01%) but available K_2O content is low (.002 to .0039%). It is this deficiency of potash that is perhaps responsible for the poor germination, stunted growth and partial yellowing of the leaves of wheat and barley plants in certain plots. The total cation exchangeable capacity of the soils varies from 25 to 35 m.eq./100 gm. soil. Potash deficiency in such soils can be corrected by the application of sulphate of potash at the rate of

80 lbs./acre, as K_2O and excess acidity may be overcome by the addition of lime at 2 tons/acre. Application of organic manure 4 to 5 tons/acre will help the soil to maintain a proper balance in plant nutrients.

32. Surface area measurements in saline-alkali soils.

R. S. MURTHY and M. A. ALI, New Delhi.

Soil particles have two types of surfaces : External and Internal. The relations between the specific surface of soils and certain physical and chemical properties were studied with the object of finding out whether the measurement of specific surface would be a useful index to these soil properties and whether they were related to total, external or internal specific surface. Ethylene glycol retention as a monomolecular layer by heated and unheated samples of some of the saline-alkali soils of west Uttar Pradesh was determined by the method given by Bower and Oschwend. Results revealed that the total surface area ranging between 38.45 and 58.93 $m^2/gm.$ had a close relation with the exchangeable sodium content in the profile, while the external surface area showed a correlation with clay content. The internal surface area of the soils ranged between 19.23 and 35.04 $m^2/gm.$ and thus to some extent was related to the cation exchange capacity.

33. Morphogenesis of some alluvial soils in Ganga river plain of Uttar Pradesh.

R. S. MURTHY and B. S. MATHUR, New Delhi.

Morphogenetical studies conducted on some alluvial soils in the Ganga river plain of Uttar Pradesh comprising the districts of Budaun, Hardoi, Sitapur, Shahjahanpur under varying rainfall and slightly changing physiography have brought out certain interesting features relating to profile development with regard to the following : (i) prominent accumulation of clay, oxides of aluminium, iron, calcium and magnesium in the profile and the zone of illuviation ranges between the depths of 12 and 48 inches; (ii) the intensity of rainfall, determines to some extent the depth of penetration of clay, silt and other mineral constituents except in places where the water table is high and that has arrested the downward leaching; (iii) silt and clay contents of soils increase with increase in rainfall; (iv) lime concretion which are secondary formations occur at lower depths of the profile due to fluctuating and bad quality of subsoil water; (v) development of alkalinity in soils due to high subsoil water containing excess of sodium and carbonate; (vi) weathering of sand fractions in the illuviation horizon.

These may form a useful basis for the classification of the Indo-Gangetic alluvium.

34. Buffer action in some laterites and associated soils.

K. V. S. SATYANARAYANA and Y. N. RAO, New Delhi.

The soils studied have been grouped into : Laterites, Detrital laterites, Red alluvial soils, and Brown forest soils. Their buffer action was followed adopting essentially the method devised by Schofield for lime requirements and elaborated by Raychaudhuri *et al.* The buffer curves were analysed and the buffer values were calculated at pH's 2.9, 4.6, and 9.8. No regular variation of $\Delta B/\Delta pH$ down the profiles is observed. In some cases the manner of variation of $\Delta B/\Delta pH$ at

the three pH values is not the same. By comparing the buffer curves and buffer values of soils, the following conclusions are drawn. Laterite at the extreme is showing buffer curves which are flatter. The buffer values are fairly high when compared with Detrital laterites and Red alluvial soils. The buffer curves of Detrital laterites follow more closely those of Laterite, while Red alluvials are much steeper than others. The Brown forest soils show high buffer values, and are nearer to Laterite. It is concluded that the analysis of buffer curves and their interpretation requires care, as there are many complex factors involved in the buffering of soils.

35. Studies on some saline and alkaline soils.

S. P. RAYCHAUDHURI and M. M. PATEL, New Delhi.

Soil Profiles from Botany Division, I.A.R.I. (Profile I); Durgapur Farm, Jaipur, Rajasthan (Profile II); Kakdeep, West Bengal (Profile III); village Baratgi, district Bijapur, Mysore (Profile IV); village Mahisbathan, West Bengal (Profile V) were studied for their physical and physico-chemical properties. They fall into the following classes: (1) saline (Profiles V and III), (2) saline-alkaline (Profile II) and (3) alkaline (Profiles I and IV). They have the following properties: (1) except in Mahisbathan, in all other profiles the percentage of exchangeable Na and K saturation is fairly high; (2) soils of Mahisbathan profile is immature while of others are mature, as indicated by the increase in the percentage of clay fraction with depth. The Mahisbathan soil occurs under swampy conditions, the internal drainage being almost absent and hence it has remained immature; (3) all the soil contain CaCO_3 in the bottom layer indicating impeded drainage; (4) the clay fraction in the profiles IV and V consists predominantly of montmorillonite with possibly some illite. The $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratio of clay fraction, however, suggests the preponderance of kaolinite. The determination of free Al_2O_3 is likely to give additional clue; (5) most of the soils in all the profiles contain illitic and montmorillonitic clay minerals.

36. Soil and land use survey of some areas in Bijapur District, Mysore State.

B. B. ROY, Nagpur.

A soil and land use survey of about 20,000 acres comprising six villages, lying at about 10 miles north of Bijapur in Mysore State was carried out for planning for better land use. Village revenue maps of scale 8 inches=1 mile were used as base maps. The climate is semi arid with moderate to severe summer and mild winter. The rainfall is low being hardly about 20 inches. The soils which belong to Bijapur series, are dark reddish brown to black clay loam to clay, medium deep to deep. Calcium carbonate is present throughout the profile, often with a distinct lime accumulation layer above the parent material. Lands are gently sloping to undulating and erosion is moderate to severe. Permeability is moderate to slow. The series has several types and phases including a saline-alkali phase. Soil maps have been prepared.

From the nature of the soil and topography of the land the area has been classified into Groups I to VII according to land use—capability classification, the dominant factors being the climate and soil erosion. Suitable recommendations for better land use have been made.

37. Calibration of soil tests by correlation with the uptake of phosphorus by wheat.

R. V. TAMHANE and V. K. SAOLAPURKAR, New Delhi.

In order to calibrate a soil test for available phosphorus study of ten different methods for extraction was made. A greenhouse experiment was conducted on 12 different soils of Delhi State, using wheat as a test crop and applying phosphorus at 5 different levels in addition to a basal dose of nitrogen and potash. The phosphorus uptake was determined in plants at flowering stage. The application of phosphatic fertilizer resulted in a significant increase in the uptake of phosphorus (over basal dose), indicating clearly the deficiency of available phosphorus in these soils. Different methods showed that the available P_2O_5 range values were increasing as the acidity of the extractant was increasing. Bray's II solution, which was highly acidic, extracted highest amounts of P_2O_5 (range 132 lbs.—1,200 lbs./acre), whereas for water extraction and alkaline solution (Olsen's method) the ranges were 1.69 lbs. to 11.70 lbs./acre and 9.2 lbs. to 40 lbs./acre, respectively. Correlation analysis showed that Olsen's method correlated significantly with the phosphorus uptake ($r = -0.752$, significant at 1% level), with a prediction value of 56.55%. This method can be effectively used to characterise the phosphorus fertility status of Delhi soils which are slightly alkaline in their reaction.

38. Retting of Jute : IX. Influence of the iron content of the fibre and the composition of retting water on the colour of the fibre.

M. K. MUKHERJEE, G. HALDER and A. K. MANDAL, Barrackpore.

Several factors influence the quality of fibre; colour is one of these factors. Due to defective retting process and/or shortage of water the fibre is often of steel grey colour (*Shyamla*). Such coloured fibre usually fetches lesser price. This colour formation has been ascribed to the Fe-content of the retting water and tannic acid of the plant. To test how far the iron content of the retting water influences the iron content of the fibre and its colour, the present investigation was undertaken. It has been found that though the total iron content of the retting water has influence on the colour, yet of the two forms of iron Fe-ous iron is more important. The calcium content, the amount of soluble solids and the nitrogen content of the retting water also exerts considerable influence on the colour of the fibre.

39. Retting of Jute : X. Influence of covering material on the colour of the fibre and retting period under Assam conditions.

M. K. MUKHERJEE and G. HALDER, Barrackpore and
S. GHOSH and D. B. DUA, Sorbhog.

In order to find out a suitable covering material locally available in abundance, in cultivator's type tanks the following materials for the 'jaks' were used: (1) shoti plant (*Curcuma zedoaria* Roscoe), (2) paddy straw, (3) water hyacinth (*Eichhornia crassipes* Solmns), (4) jute leaves (*C. olitorius*) and (5) mud and banana stems (normal practice). JRC-321, a recommended variety of *C. capsularis* for Assam was used for the study.

In case of 'shoti plant', 'paddy straw' and 'water hyacinth' the retting period has been shortened by 3 days as compared to local practice. With 'water hyacinth' the iron content is the least and with 'mud and banana stems' (local practice)

it is highest. With 'jute leaves' (*C. olitorius*) and 'paddy straw' it is similar. It is, therefore, expected that the 'shoti plant' or the 'water hyacinth' will give the best colour. As the retting period is also less they are expected to give fibre of better quality. Since very minute tinge of golden colour is preferred, 'shoti plant' gives the best fibre followed by 'water hyacinth'.

40. Decomposition of hemicelluloses during retting of ramie (*Boehmeria nivea*).

A. K. KUNDU and A. K. BANERJEE, Barrackpore.

The separation of fibre bundle in the stem of a fibre yielding plant is effected by the breaking down of the soft cells surrounding them during retting. It is generally considered that the separation is due to decomposition of the pectic substances present in the walls of such cells. It is found that besides pectin, hemicelluloses are decomposed during the retting of hemp and jute.

A strain of *Aspergillus niger* and a species of monoverticillate *Penicillium*, both possessing pectin and hemicellulose splitting capacities, were used for retting of ramie. It has been found that all the sugars present in the hydrolysates of the two hemicellulose fractions isolated from ramie have also been detected by paper chromatography in the retting system of ramie both with *A. niger* and the *Penicillium* sp. Barks of ramie does not contain any free sugar except glucose, fructose and sucrose. This obviously shows that hemicellulose present in the plant are decomposed into component sugars by these during retting.

41. Effect of different types of water on availability of plant nutrients in soils of different types.

A. K. MANDAL, A. B. ROY and M. K. MUKHERJEE, Barrackpore.

Attempts are being made now-a-days in India to irrigate large area through tube well, well and tank-irrigation etc. A study was, therefore, undertaken to find the effect of irrigation water on different soils affecting availability of plant nutrients. Soils from Barrackpore (sandy loam), Tarakeswar (loamy sand), Kati-har (loam), Kendrapara (red alluvial), Kamargoan (rich in organic matter), Sorbhog (sandy), Chinsurah (heavy clay) Gograghat (loam, alkaline), Jorhat (loamy sand, acidic) and Canning (saline) were taken and water from a tidal canal, during high tide and low tide, pond water, rain water tube-well water and distilled water were used for this study.

Data for available nitrogen, pH, available phosphorous, organic carbon, *Azotobacter*, total bacteria, fungi and actinomycetes show that the available nitrogen and phosphorus and micro-organisms fluctuate differently in different types of soils treated with different waters. Thus it appears that with different types of soils the nature of irrigation water is important in crop production and manuring schedule may have to be adjusted depending on the nature of water used for irrigation.

42. Comparative effect of application of ammonium sulphate and ammonium chloride on the lime status of Barrackpore soil.

S. C. CHAKRAVORTY, M. K. MUKHERJEE, H. PAL, Barrackpore.

The yield of jute fibre responds most to the application of nitrogenous fertilizers, particularly ammoniacal ones. Although amongst the nitrogenous fertilizers, ammonium sulphate is most popular but the present anticipated production in our country is not likely to be sufficient to meet the estimated demands. So the large

amount of chlorine produced as bye-product from caustic soda plant if usefully combined with synthetic ammonia to form ammonium chloride or NH_4Cl obtained as a by-product in the soda ash process, the nitrogen demand of the country can be partly met with. It has been found in the laboratory experiment that the leaching actions of ammonium sulphate and ammonium chloride do not vary much, so far as exchangeable calcium is concerned. Although there is a fall of pH due to application of both the fertilizers in Barrackpore soil but trend is more or less same with moderate dose of both the fertilizers.

With the application of nitrogenous fertilizers at a comparatively lower dose, there is an increase of organic matter due to microbial activity but there is difference in the behaviour of ammonium chloride with that of ammonium sulphate. This has been presented in the paper.

43. Study of a soil sequence on granite-gneissic parent material.

T. D. BISWAS and M. R. NARAYANA, New Delhi.

Topography appears to be the predominating factor in the formation of a sequence of soils. In the Adoni taluka in Kurnool district (Andhra Pradesh), repetitive series comprising red and black soils in the crests and troughs of the undulating landscape, with brown soils at the intermediate position of the slope, suggest catenary relationship amongst the soils.

Profiles of these soils show morphological features which are in regular gradation as that of the toposequence. Depth of the solum, pH, content of calcium carbonate and clay increase, structure changes from sub-angular blocky to granular and texture changes from sandy loam to clay from red to black soils through the brown, down the slope. Same regular gradation is revealed in the chemical composition, base exchange capacity and the mineralogical make up. Silica decreases whereas sesquioxides, calcium, magnesium and manganese increase down the slope gradually. Cation exchange capacity and X-ray diffraction pattern show interesting shift in the mineralogical make up of the clay fractions, montmorillonite transforming into illite and kaolinite depending upon the intensity of drainage condition and topography, up the slope. The red soils which are more weathered, are formed under well drained conditions, whereas the black soils have been formed under impeded drainage conditions.

44. Genesis of black soils from trappean rock in Indore.

T. D. BISWAS and S. P. BANERJEE, New Delhi.

Normal profile has dark grey A horizon directly overlying the C horizon of soft murram without any transitional illuvial horizon. The soils are highly clayey, the clay content remaining uniform throughout the profile and the granular structure at the surface changing to angular blocky down below. They are alkaline and lime concretions are distributed throughout the profile, the tendency being gradual increase with depth. The chemical composition bears relationship with the parent rock. The first stage of weathering of trap rock appears to be desilicification; the reverse process takes place at the subsequent stages of soil genesis with enrichment of silica and diminution of sesquioxides. The parent material appears to play a dominant role in the formation of these soils under the prevailing climatic conditions and characterises them with high base exchange capacity, complete base saturation, and calcium as the predominant exchangeable cation. The clay fractions exhibit uniformity in chemical composition and the high silica : alumina ratios indicate the siallitic character. The silica : sesquioxide ratio, X-ray

diffraction pattern, and the high cation exchange capacity of the clay fraction establish the dominance of montmorillonitic type of clay minerals.

These black soils compare well with the Houston black clay of the U.S.A. and the black earths of Australia.

45. Soil Phosphorus Fractions as affected by Annual Application of Bonemeal and their Influence on the Yield of Paddy.

S. DIGAR and A. K. MANDAL, Calcutta.

When phosphatic manure is added to a soil, it decomposes and forms compounds which become part of the soil phosphorus. Soil phosphorus may be separated into different fractions viz. (1) acetic acid soluble, (2) alkali soluble inorganic, (3) alkali soluble organic, (4) sulphuric acid soluble and (5) insoluble fraction.

In the present investigation, the soils and crop of an experiment with bonemeal on Aman paddy, which is being continued since 1944, have been analysed after 10 years of the experiment.

From the results of analyses of soil it is seen that N/2 acetic acid soluble phosphate and N/4 sodium hydroxide soluble organic phosphate have not accumulated in the soil. The N/4 sodium hydroxide soluble inorganic phosphate and 2N sulphuric acid soluble phosphate have accumulated in the soil.

It is concluded that the first two fractions which have not accumulated in the soil have been either consumed by the crops or lost by drainage.

46. Synthetic polyelectrolytes as soil conditioners.

RAM PRAKASH, TRILOKI NATH and B. R. NAGAR, Calcutta.

Three synthetic polyelectrolytes—kriium loamaker (100% active) supplied by Monasanto Chemical Co., U.S.A. and hydrolysed polyacrylonitrile (HPAN) and copolymer of styrene and maleic acid (SMA) prepared by us were treated at the rate of 0.02%, 0.05%, 0.1% and 0.8% on dry basis with alluvial soil, black soil and laterite soil under laboratory conditions. The soil aggregation, as determined by Yoder's wet sieving procedure, was increased in all soil samples as a consequence of treatment with synthetic polyelectrolytes. The effectiveness of the synthetic polyelectrolytes on the aggregation of the typical Indian soils can be put in the following order—black soil>laterite soil>alluvial soil.

47. Physicochemical studies on starch from the kernel of water chestnut (*Trapa bispinosa* Roxbg.)

V. L. N. MURTY, D. CHOUDHURY and P. BAGCHI, Calcutta.

The starch present in water chestnut (*Trapa bispinosa* Roxbg.) has been isolated and obtained free from protein according to the procedure of Cowie and Greenwood. It has been fractionated into its component amylose and amylopectin using thymol as the precipitant for the amylose. The thymol amylose complex was directly dispersed in boiling water and the amylose re-precipitated by saturating the solution with butanol. Periodate oxidation indicated that the amylopectin contained the normal type of branched structure, but with one non-reducing terminal group per 11 ± 1 glucose residues. Some physical properties on the acetylated fractions including molecular weight by light scattering and viscosity measurements were carried out.

The fractions were characterised by their iodine binding power and X-ray photographs. Purity of the amylopectin and amylose were determined by the hydrolysis and the estimation of the glucose obtained by alkaline ferricyanide method.

48. Study of the pectin from ripe and unripe mango (*Mangifera indica*).

A. DAS, D. CHOUDHURY and P. BAGCHI, Calcutta.

Both the pectins were extracted by hot 0.5% ammonium oxalate solution and then precipitated by acidified alcohol. The product after purification was a white powder soluble in hot water and having the following characteristics: unripe mango pectin—moisture=13.429%, ash=0.6376%, pentosan=20.6%, methoxyl=3.03%, uronic acid=25.6%, equivalent weight, as determined by potentiometric titration=1162.31 and specific rotation $[\alpha]_D^{20} = +60^\circ$ (C, 1 in N NaOH soln.). On complete hydrolysis this pectin was found to contain D-glucose and L-arabinose in the proportion of 12:1, besides uronic acid. The pectin has been completely methylated (CH_3O —40.26%). Identification of the methylated sugars is under progress.

For ripe mango pectin—moisture=14.66%, ash=0.7%, pentosan=3.06%, uronic acid=6.88%, methoxyl=1.39%, equivalent weight by potentiometric titration=8071.24. On complete hydrolysis the pectin was found to contain only D-glucose, confirmed by derivatives.

49. Methylation studies of the galactomannan obtained from tender palm kernel (*Borassus flabellifer* Linn.).

A. K. MUKHERJEE, D. CHOUDHURY and P. BAGCHI, Calcutta.

The galactomannan was methylated by dimethyl sulphate and alkali and then by methyl iodide and silver oxide when a very light yellow flaky product showing no hydroxyl band at $3500\text{--}3600\text{ cm.}^{-1}$ in the infra-red spectrum, was obtained. It had methoxyl 43.25% and $[\alpha]_D^{20} = +28.7^\circ$ (C, 1 in chloroform). The molecular weight of the methylated galactomannan as estimated by light scattering method was found to be 1.39×10^5 .

The methylated galactomannan was hydrolysed after methanolysis and the methylated sugars were separated by column chromatography on a cellulose column using butanone-water azeotrope as the irrigating solvent, into four fractions. These contain one dimethyl mannose, one tri-methyl galactose and one tri-methyl mannose and a tetra-methyl galactose. Of them the tetra-methyl and one tri-methyl sugars have been identified as 2, 3, 4, 6-tetra-O-methyl-D-galactose and 2, 3, 6-tri-O-methyl-D-mannose.

50. Water soluble polysaccharide from coconut (*Cocos nucifera*).

C. V. N. RAO, D. CHOUDHURY and P. BAGCHI, Calcutta.

The polysaccharide was isolated from the oil free coconut kernel with water in the usual manner. For removal of minor impurities the polysaccharide was precipitated by complexing with Fehlings solution. The purified polysaccharide was colourless amorphous powder, has mannose and galactose in the ratio 2:1 and $[\alpha]_D^{20} = -84.9^\circ$ in 4% alkali (C 1).

The polysaccharide on methylation with dimethyl sulfate and alkali and then with silver oxide and methyl iodide yielded a fully methylated polysaccharide which showed $[\alpha]_D^{20} + 25^\circ$ in chloroform (C 1).

The methylated polysaccharide was hydrolysed after methanolysis and the methylated sugars were separated on cellulose column using butanone—Water azeotrope. The following sugars, 2 : 3 : 4 : 6-tetra-O-methyl-D-galactose, 2 : 3 : 4 : 6-tetra-O-methyl-D-mannose, 2 : 3 : 6-tri-O-methyl-D-galactose, 2 : 3 : 6-tri-O-methyl-D-mannose were identified. The unidentified di-O-methyl sugar was believed to be 3 : 6-di-O-methyl-D-galactose. The ratio of tetra : tri : di was 1 : 6 : 1.

The above result was corroborated by periodate oxidation. It is suggested that the polysaccharide was 1→4 linked galacto-mannan where D-galactose and D-mannose were present in their β -pyranose form. The repeating unit was eight hexose molecules.

51. Hemicellulose from pea-skins (*Pisum-sativum*).

N. BANERJI, D. CHOUDHURY and P. BAGCHI, Calcutta.

The hemicellulose was isolated by precipitation of a 4% sodium hydroxide extract of the pea-skins with acidified acetone. After purification it was obtained as a brownish amorphous powder having the following characteristics : Pentosan = 62.06% ; ash = 2.02% ; moisture = 10.23%. (The water-solution was found to be neutral, hence it was concluded that there is no uronic acid residue in it). The hemicellulose on hydrolysis with 2N sulphuric acid on a water-bath for twenty-four hours gave sugar-mixture which on paper partition chromatography, using different irrigating solvents, revealed the presence of xylose, arabinose, galactose and some quick-running unknown sugar.

52. Quantitative determination of sulfur by amperometric titration.

PRANOY K. CHATTERJEE, D. BANERJEE and ANIL K. SIRCAR, Calcutta.

The method of amperometric titration has been applied for the quantitative determination of S by conversion to KSCN by KCN with a suitably modified amperometric titration set. It has been seen that other constituents which might be present in a solvent extract of a rubber vulcanised with mercaptobenzothiazole e.g. mercaptobenzothiazole (MBT), mercaptobenzothiazolyl disulfide (MBTS) and zinc benzothiazolyl mercaptide (Zn-MBT) have got no influence if titration be carried out with an extract from distilled water. The method is very quick, can be employed for very dilute and coloured solution and does not need any temperature control.

53. Properties of Ganges silt.

R. K. SEN and B. CHATTERJEE, Palta and Howrah.

The seasonal variations in the properties of Ganges silt, the sedimentation volume on the addition of cetyl-trimethyl-ammonium-bromide to the hydrogen clays prepared from silt samples collected at Palta (Barrackpore) during the pre-monsoon and monsoon seasons for four consecutive years has been determined. The effect of the removal of free inorganic oxides has also been studied. It has been observed that the sedimentation volumes of the H-clays prepared from monsoon silts are higher compared to that of the premonsoon silts. The sedimentation volumes have been found to be higher on the removal of free inorganic oxides, the

effect being more pronounced in the case of monsoon silt samples. These results are in line with those reported previously, viz., the premonsoon silts are mainly kaolinitic whereas the monsoon silt samples are dominantly illitic.

54. Properties of ternary mixtures of clay minerals.

M. SARKAR and B. CHATTERJEE, Howrah.

Studies have often been made on the differential thermal analysis and on the variations in the pH, specific conductivity, cation activity and viscosity on the progressive addition of bases to ternary mixtures (40% kaolinite : 20% illite : 40% montmorillonite ; 80% kaolinite : 10 % illite : 10% montmorillonite ; 10% kaolinite : 30% illite ; 60% montmorillonite and 40% kaolinite : 40% illite : 20% montmorillonite). An examination of the total acidities and pH at inflexion, cationic dissociation, variation of viscosity and of the differential thermal analysis data indicate that individual constituents markedly influence the properties of other constituents. This observation is of fundamental interest in the identification and estimation of clay minerals present in soils.

55. Physical, electrochemical and viscous properties of binary mixtures of clay minerals.

M. SARKAR and B. CHATTERJEE, Howrah.

Studies have been made on the variations in the pH, specific conductivity and viscosity on the progressive addition of bases to binary mixtures (20 : 80, 50 : 50, 40 : 60, 80 : 20, by weight) of montmorillonite, kaolinite and illite. Differential thermal analysis studies have also been made with these mixtures. It has been observed that individual clay minerals can be easily detected in these mixtures by a combination of chemical, electrochemical and differential thermal analysis studies. Any single method may lead to erroneous result. In agreement with previous observations, it has been found that each clay mineral exerts a marked influence on the properties of the other in the mixture.

56. Adaptability of rapid tests for available phosphorus on some Indian soils.

R. V. TAMHANE and A. S. KOLARKAR, New Delhi.

Rapid soil-tests, when properly correlated with crop response to phosphorus application on different soil types, could give a valuable information in grouping soils according to their phosphorus status. Response of wheat to phosphorus application on 12 different soil types was obtained and soil-test values for P by 10 different methods of P extraction were correlated with it. Suitability of method was judged by comparing the correlation co-efficients and prediction values. Methods, as arranged according to their suitability, were Spurway's, Morgan's, Truog's Bray's P_i test, Jacquet and LeNir's, Bray's P_i test and Olsen's. Versene fluoride, Bingham's and citric acid methods did not give significant correlations. As most of soils were acidic in nature, acid extractants only proved better on these soils. Only Olsen's method, using alkaline extractant, showed that it could give correlation on acid soils too but was not better than acid extractants. Spurway's method gave the prediction value as high as about 80%, proving again the best. It could group the soils into 3 classes according to the degree of per cent response obtained on them. Unless the results are confirmed at respective centres under the native climatic condition, no method should be taken as crop index.

57. Properties of the basaltic soils as related to rainfall.

R. V. TAMHANE and R. L. KARALE, New Delhi.

Clay content of the surface soils bear a direct positive relationship with rainfall. Silt and sand content showed inverse relationship. Other physical properties, like water holding capacity and moisture equivalent, were influenced by rainfall.

With increasing rainfall silica content was found to decrease in the surface soils and leaching to lower layers. R_2O_3 content of the surface soils from high rainfall area was of the order of 41.05%—42.50%, whereas that of the moderately low was between 29.08—32.12%. Cation exchange capacities of the soils and clays and the molar ratios SiO_2/R_2O_3 and SiO_2/Al_2O_3 were found to decrease with increasing rainfall.

Montmorillonite type of clay mineral was found to dominate the soils from low to moderately low rainfall areas, whereas kaolinite dominate the soils from high rainfall areas.

Minerals of zeolite group especially stilbite were found to occur abundantly in the soils of low to moderately low rainfall areas, and play an important role in contributing towards the c.e.c. of the soils. Cation exchange capacity of the stilbite (0.2—0.085 mm. size) was 43.5 m.e./100 grams.

The soils under study were derived from basaltic parent material in localities viz. Paud, Kamshet, Malvali, Trimbak and Ahwa, receiving rainfall of 60", 70", 80", 90" and 100" respectively.

58. Evaluation of nitrogen supplying power of soils by soil tests.

B. V. SUBBIAH and A. R. KALBANDI, New Delhi.

Suitability of different methods for predicting the nitrogenous fertilizer needs in Delhi soils, by evaluating the correlations between soil tests and crop responses obtained in pot and field experiments, led to the following conclusions: (1) the determinations of total nitrogen or organic carbon is no index of the availability of nitrogen to crop; (2) the incubation procedures, like Iowa nitrification method and standard incubation procedures, have shown correlations between the mineralisable nitrogen values, per cent yields and the uptake of nitrogen by the crop; (3) highest correlations with per cent yields were obtained with alkaline potassium permanganate method; (4) the available nitrogen values in the surface soils showed no correlations with the corresponding subsoils; (5) from the regression equations fitted with data obtained between available nitrogen, as obtained by alkaline potassium permanganate method with corresponding per cent yields to each rate of nitrogen application, it will be possible to calculate per cent yields that can be expected at any given soil test values from different rates of nitrogen application. In order to have more reliability, it will be necessary to evaluate such curves with the yield figures obtained over several years.

59. The influence of different nitrogen sources on the rate of growth of *Colletotrichum falcatum* Went.

A. K. MOHD. GHOUSE and ABRAR M. KHAN, Aligarh.

The effect of twenty eight different nitrogen sources on the rate of growth of *Colletotrichum falcatum* Went, (light coloured and heavily sporulating isolate) has been determined.

The isolate is capable of utilizing a large number of organic nitrogen as well as the inorganic nitrogen sources. Dl. aspartic acid, sarcosine and dl. valine sup-

port best growth, while dl. alanine, l. leucine, l. arginine, l. histidine dl. glutamic acid, asparagine and peptone support moderately good growth. On glycine, dl. serine, phenylalanine, dl. lysine, dl. tryptophane, dl. methionine and urea the growth is poor while there is little or no growth on creatine, l. cystine, l. cysteine, and tyrosine.

Growth in potassium nitrate is more than in ammonium nitrate and ammonium sulphate. However, the addition of calcium carbonate increases the growth of the fungus in media containing nitrogen in the form of ammonia. This could be attributed to the neutralizing effect of calcium carbonate.

60. Seasonal variation in the microbial count in tropical soil of Agra.

NEWTON RAM and A. K. BHATTACHARYA, Agra.

In the months of January and June, the total bacterial count was maximum in an Agra soil. It was observed that when the bacterial counts were at the peak, those of fungi and *Azotobacter* were at the minimum. Similar observations have been made regarding the growth and decay of fungal and bacterial population in temperate zone. It is rather striking that the bacterial count in the tropical soil of Agra and in colder countries go high in the month of February. It appears that the environmental conditions in the cold and hot countries approach a similarity during the spring season.

61. Studies on the microbiology of rhizosphere of *Corchorus olitorius* : IV. Nitrogen fixing capacity of the rhizosphere and non-rhizosphere soils.

A. B. ROY and A. K. BANERJEE, Barrackpore.

It was reported in a previous communication that *Azotobacter* was more abundant in the rhizosphere of the jute plant than in the non-rhizosphere soil. Since then the presence of *A. chroococcum* has been detected on the root surface at various stages of its growth. The nitrogen fixing capacity of the rhizosphere and control soils was compared. Several samples taken from different experimental plots showed that though the *Azotobacter* population was, in general, 2-3 times more dense in the rhizosphere than in the control soils, the nitrogen fixing capacity of the two soils did not differ significantly. Under the conditions of this study the plant is not much benefited, so far its nitrogen nutrition is concerned, by the presence of a large number of *Azotobacter* cells in its rhizosphere.

62. Culture of leguminous root nodule in laboratory.

A. K. MUKHERJEE and P. N. BHADURI, Calcutta.

Considerable difficulties are encountered in obtaining suitable root nodules of leguminous plants, grown in tropical field conditions, for studying their morphogenesis. Different authors have reported cultures of leguminous plants in liquid, gelatinous and sand media. A simple method has been developed for obtaining healthy nodules at the desired stage of development in test-tube cultures.

A pure culture of nodule bacteria was obtained on yeast-water-agar from nodulated plants grown in the field. As done in the case of bud-grafting, a 'T'-incision was made on a piece of blotting paper (6"×1½") at a height just above 4" from the bottom. The paper was then pressed to the inside wall of a tube (10"×1¼") and dry sand was poured to make the level just under the incision. The sand was

soaked in nitrogen deficient culture solution. The tube was sterilized. Healthy legume seeds were superficially sterilized and washed in sterile distilled water and soaked in water for 4-6 hours. A seed was aseptically transferred into the 'T' incision of a culture tube and allowed to germinate. 7-days-old subculture of *Rhizobium* was diluted in sterile tap water and 5 c.c. of it was aseptically injected to a culture of legume seedling. The cultures were maintained in glasshouse and the root system was protected from light.

Cowpea, *Lathyrus* and *Phaseolus* seedlings were grown in this way and their morphogenesis was studied.

62A. Isolation of *Rhizobium* bacteriophage from soil and plaque formation in agar plates.

ITU SANYAL, and P. NANDI, Calcutta.

Strains of *Rh. leguminosarum* were isolated from root nodules of *Sesbania cannabina* Pers. and the effectiveness of isolates were verified by inoculation of seedlings of respective host plants.

Bacteriophage was isolated from soil collected from the beds of *Sesbania* following the method of Bottcher. To detect the action of phage, preliminary screening test was done. Growth of the *Rhizobium* sp. was studied in liquid culture medium in the presence of phage and its lytic action was noted. Qualitative estimation of the phage was done by plaque counter method.

The results show that the *Rhizobium* bacteriophage occurs in most soils and are abundant while the host plants are grown.

PESTS AND DISEASES

63. Resistance of barley varieties against covered smut (*Ustilago hordei* Pers. Kellerm and Swingle).

R. S. MATHUR and S. C. VERMA, Kanpur.

Barley is the second important rabi crop in India. Its use as food for the millions and in the brewing industry has increased its economic value. The covered smut of barley caused by *Ustilago hordei* is a common disease.

Although the fungus is externally seed borne and is effectively checked by seed dressing with Agrosan G. N., importance of research on evolving covered smut tolerant barley varieties cannot be minimised. Hence experiments were conducted to test 13 varieties of barley. Before sowing the seeds were artificially inoculated by the standard vacuum method to enable the spores to stick to seeds between the glumes.

Varieties C50, K18, CN292, C84, K19 and Bajpur local have shown fair tolerance to covered smut, infection percentage being below 2%, while varieties NP21, K12, C251 and CN294 showed infection percentage between 3.98-7.2%. Variety KN17 showed the maximum infection up to 21% followed by KN15 and KN16, showing 10.8% and 9.1% respectively.

Variety C50 was released in 1956 in Bareilly region of Uttar Pradesh. Other fairly tolerant varieties for example K18 and K19 which are also heavy yielding, are being considered for release during the ensuing Rabi Season.

64. Resistance of barley varieties against loose smut (*Ustilago nuda* Jens. Roster).

R. S. MATHUR and K. N. SAKSENA, Kanpur.

Apart from its use as staple food barley is equally important in brewing industry. Appreciable damage is estimated to be caused by loose smut (*Ustilago nuda*). 0.1% infection causes an average loss of 1,000 tons in Uttar Pradesh.

In an attempt to ascertain varieties resistant to loose smut (*Ustilago nuda*), an experiment was laid out at the Government Research Farm, Kanpur. So far thirty-five varieties have been tested for the last six years. Seed previously inoculated with viable loose smut spore suspension, by Moore's 'partial vacuum method' were sown in order to create maximum artificial epidemic. Variety I.W.112/B-2 of Russian origin which had escaped infection of loose smut in its first year of trial, proved to be moderately susceptible. Maximum infection upto 62.3% has been obtained in Variety I.W.112/B-5, followed by Flynn (Australian) having 55.5% infection. Variety C50, released in Barielly region of Uttar Pradesh, continued to be moderately resistant. Other varieties which have shown fair tolerance against loose smut are C44, CN292, Black barley, NP13, and CN294.

65. Resistance of gram varieties against wilt.

R. S. MATHUR, J. S. JAIN and S. C. ATHEYA, Kanpur.

Wilt of gram is a soil borne disease. Evolution and planting of the varieties of gram which are resistant to wilt is, therefore, the best method of control of the disease. A large number of varieties of gram for their resistance to wilt (*Fusarium orthoceras* var *Cicerie* Appel. and Wollenw.) is in progress for the last ten years.

Tests have been carried out in a severely wilt sick nursery. Observations were taken periodically when counts of healthy and wilted plants were made separately and consolidated in the end of the experiment each year.

Out of ninety-six varieties included in the tests, strain 106 showed comparatively better tolerance to wilt (0.0—34.7% infection) as against T87 which showed up to 87.9% infection in ten years of their trials. Strains 45, 305, 322, 44-7, 195 and others were affected to the extent of over 90% infection and were therefore excluded from the experiments after two years of their trial in the wilt sick plot.

Strain 106 is a late maturing brown and medium sized gram variety obtained from Bihar. The plants are semi-erect with good fruiting yielding 18-20 mds. per acre.

66. Some newer insecticides for the control of *Gnorimoschema operculella* Zell in seed potatoes.

SARDAR SINGH and M. S. GURMA, Ludhiana.

Cold storage of potato tubers is the best preventive against the attack of *Gnorimoschema operculella* Zell. As such facilities are not yet available in the hilly tracts of the Punjab, insecticides were tried for its control. Experiments conducted during the crucial period of eight weeks of high incidence of the pest (July to September) in the year 1957 and 1958 at Palampur (Kangra) showed that various dusts mixed with seed tubers, reduced infestations of the tubers from 11.47% in control to 4.70% in pure *dharek* (*Mella azedarach*) fruits dust @6 ozs.

per maund, 3.92% in aldrin 1% @10 ozs. per maund, 2.54% in heptachlor 3% dust @4 ozs. per maund, 1.83% in DDT 5% dust @2 ozs. per maund, 1.71% in chlordane 5% dust @2 ozs. per maund, 1.63% in aldrin 1% dust @15 ozs. per maund, 1.25% in BHC 5% dust @2 ozs. per maund, 1.23% in chlordane 5% dust @3 ozs. per maund, 0.70% in DDT 5% dust @3 ozs. per maund, 0.57% in BHC 5% dust @3 ozs. per maund, and nil in pure sweet flag roots dust @6 ozs. per maund. Potatoes treated with the above dusts could, however, be used for seed and not culinary purposes.

67. Effect of temperature and humidity on the development of *Corcyra cephalonica* Stainton (Pyralididae : Lepidoptera).

G. S. KALKAT and G. S. SOHI, Ludhiana.

Development of *Corcyra cephalonica* Stainton was studied at 27°C, 30°C, 33°C, 36°C and 39°C and at 40%, 70% and 90% relative humidities.

The incubation period of eggs was 80.7 hours at 30°C × 90% R.H. These conditions appear to be close to optimum. The duration of larval stage was lowest (21.55 days) at 30°C × 70% R.H. or 90% R.H. At 39°C, however, the caterpillars died within eight hours of emergence. The duration of the pupal period varied with temperature. Temperature did not influence the preoviposition period within the range of 27°C to 36°C, while it varied with humidity. The oviposition period and the fecundity were adversely affected by the increase in temperature. Higher humidity prolonged the oviposition period and increased the total amount of oviposition, the oviposition period being 5.05 days at 27°C and 2.49 days at 36°C. The adults were short-lived at higher temperatures and long-lived at higher humidities. The males completed their larval and pupal stages earlier than the females. They also lived longer than the females. The optimum conditions for development of the insect appear to be close to 30°C × 70% R.H. or 90% R.H.

68. Trials of some local plant products against jassid (*Empoasca devastans* Distant).

G. S. SOHI and M. S. GURAM, Ludhiana.

Empoasca devastans Distant infests a large variety of crops in the Punjab but inflicts serious damage to lady's finger, American cotton and potatoes. With a view to explore the possibilities of plant wealth of the Punjab in insect control, leaves of *ak* (*Calotropis procera*), *kanker* (*Nerium odorum*), *satyanasi* (*Argemone mexicana*), *jhaov* (*Artemisia vulgaris*), *phulnoo* (*Lantana* sp.), *dandathoar* (*Euphorbia royleana*), fruits of *dharek* (*Melia azedarach*), *dhatara* (*Datura alba*), *hermal* (*Peganum harmala*), *aksan* (*Withania somnifera*) and sweet flag roots (*Acorus calamus*) were collected from the plains and hilly areas. These were tried as dusts, water decoctions and ether extracts under laboratory and field conditions. Pure dusts did not prove effective. Water extracts, except that of hermal and sweet flag failed to give any satisfactory control. Fifty per cent water extract of hermal fruits, however, yielded highly significant results giving a nymphal mortality of 93.3% and 91% under laboratory and field conditions respectively. The nymphal mortality in case of water extract of sweet flag roots was 98.8% under laboratory conditions but it effected the foliage adversely. Ether extracts (50%-10%) showed encouraging results but proved phytotoxic. When the concentration was reduced (5%-2.5%) to avoid phytotoxicity, their performance was rather poor.

69. Trials of some insecticides of vegetable origin against Mustard aphid *Lipaphis erysimi* (*Siphocoryne indobrassica*) (Kalt).

G. S. SOHI and M. S. GURAM, Ludhiana.

Mustard aphid (*Lipaphis erysimi* (Kalt)) is a serious pest of cruciferous crops in the Punjab. The insecticidal properties of leaves of *ak* (*Calotropis procera*), *kaner* (*Nerium ororum*), *salyanasi* (*Argemone Mexicana*), *jhao* (*Artemisia vulgaris*), *phulnool* (*Lantana* sp.), *dandathoor* (*Euphorbia royleana*), fruits of *dharek* (*Melia azedarch*), *dhaturo* (*Datura alba*), *hermal* (*Peganum harmala*), *aksan* (*Withania somnifera*) and sweet flag roots (*Acorus calamus*) collected from different regions of the State were tried in the form of dusts, water decoctions and ether extracts against this pest, under laboratory and field conditions during the year 1953-54 and 1954-55 at Ludhiana.

Pure dusts did not prove effective. Water decoctions gave unsatisfactory results, except in case of sweet flag roots where 100% decoction gave good kill but affected the foliage adversely. Reduced concentration of 50% yielded low mortality (i.e. 37.9%—51.3%). Ether extract emulsion (0.75%) of sweet flag roots gave 94.3% mortality under field conditions and did not affect the foliage.

70. A spray schedule for the control of some important pests of cotton.

SARDAR SINGH and A. S. SIDHU, Ludhiana.

As the population of jassid (*Empoasca devastans* Distt.) and whitefly (*Bemisia tabaci* Genn.) builds up again within 10-15 days of their control, mixtures DDT+BHC or endrin or parathion emulsion were sprayed at regular intervals during July to September, 1958. 10 and 14 days schedules succeeded in keeping the pests effectively suppressed in the case of DDT+BHC or endrin, and there was little significant difference between the two. Jassid and whitefly population did not rise beyond 15-20% of that in the untreated crop during the intervening period. In the third schedule, where these sprayings were carried out alternately at 7 and 21 days intervals, the pest population rose to 40-60%. Pest population, in the case of parathion spraying continued to remain high as it had comparatively lesser residual effect as compared to DDT+BHC or endrin. A fourteen day schedule is recommended, since it is less costlier than the ten day schedule.

71. Biology and control of citrus psylla (*Diaphorina citri* Kuwayama) in the Punjab.

BALDEV SINGH MANGAT and SARDAR SINGH, Ludhiana.

Detailed observations on the biology of insects showed that its pairs remained in coitus from 7.23 ± 3.81 to 21.66 ± 4.67 minutes. Females started egg laying immediately after mating and the oviposition period was from 11.60 ± 3.00 to 26.66 ± 8.01 days. Immediately after laying the last quota of eggs the females died, though they were longer-lived than males. The egg stage lasted on the average from 2.92 ± 0.13 to 11.95 ± 0.95 days depending upon the environmental temperature. They were laid singly or in groups. Nymphs passed through five instars in 9.50 ± 1.06 to 36.38 ± 1.26 days to reach the adult stage. Though damage was caused both by nymphs and adults, the former were more destructive since they sucked sap from the tender shoots making them dried up.

Various concentrations of different insecticides were tried. BHC (suspension) 0.2%, DDT (suspension) 0.15%, dieldrin (emulsion) 0.045%, endrin (emulsion)

0.02% and diazinon (emulsion) 0.02% at the rate of 2 gallons per tree gave from 93.12 to 100% mortality of both the adults and nymphs in the orchards. BHC and DDT were comparatively more economical to use than the other insecticides.

72. Bionomics and control of *Rhizopertha dominica* Fabricius.

SWARAN SINGH BAINS and SARDAR SINGH, Ludhiana.

Rhizopertha dominica Fabricius is a cosmopolitan pest attacking a large variety of stored products including grain.

In laboratory beetles started laying eggs 7.6 to 10.6 days after emergence from grain. The egg stage lasted for 6.05 ± 0.049 days (August) to 7.68 ± 0.056 days (October). The larvae entered the grain in 1-2 days after hatching. The larval+pupal stage inside the grain varied between 25.9 ± 0.12 days (August) to 35.0 ± 0.14 days (April). Both larvae and adults were found destructive but the main damage was done by adults beetles.

The development of *Rhizopertha* in various foods were in the order jowar>wheat>maize>rice. The percentage attack to the grains and loss in weight was also in the same order.

Covering the grain with sand completely prevented the entry of adults. Mixing dung-ash gave appreciable control. Sweetflag root dust effectively checked the multiplication of the insect. Chemical dusts, such as parathion, RBC and dieldrin, did not allow any damage by introduced insects. The beetles of *Rhizopertha* when liberated on cemented surface sprayed with various insecticides were found to be more susceptible to parathion, endrin, and BHC emulsions, than to other insecticides. Ethylene dichloride and carbon tetrachloride mixture and methyl bromide gave complete kill of immature stages of adults after 96 hours and 10 hours exposure respectively.

73. Comparative Toxicity of different insecticides to control *Epilachna vigintioctopunctata* Fabr. (Coccinellidae-Coleoptera) attacking Brinjal crop.

N. SHI and B. N. SATPATHY, Bhubaneswar.

The object of present investigations was to determine under field conditions the effectiveness of new synthetic organic insecticides for the control of *Epilachna vigintioctopunctata* F. The experiment was carried out in the randomized block design, there being five replications for each of the 6 treatments (including check) and the size of each plot being 22' x 18'. The insecticides tried were parathion (0.025%), endrin (0.04%), malathion (0.2%), BHC (0.25%) and toxaphene (0.25%). The statistical analysis of the data on population of *Epilachna grubs* showed highly significant reduction 48 hours after application. BHC proved to be least effective. The percentage decline of grub population in all the treated plots, excepting plots treated with BHC, were significantly higher than in the check plots.

One week after the application, parathion gave excellent protection from the pest. The percentage decline of grub population in parathion treated plots was significantly higher than in the plots treated with endrin, malathion, toxaphene and BHC. There was no significant difference among the treatments of endrin, malathion, toxaphene and BHC, though endrin gave slightly better result.

74. Tests of insecticides for control of Jassids, *Empoasca devastans* Distant attacking Lady's finger (*Hibiscus esculentus*).

N. SHI and B. N. SATPATHY, Bhubaneswar.

Empoasca devastans Dist. commonly known as cotton jassid is one of the serious pests of lady's finger (*Hibiscus esculentus*) and is widely distributed all over Orissa. In view of the seriousness of the problem, attention has been paid to study the toxicity of various insecticides for controlling this pest. The field trial was conducted during the year 1959 on red variety of Bhindi in the randomised block design, there being 5 replications for each of the three treatments and one untreated. The insecticides tried were parathion 0.02%, endrin 0.025% and pyrocolloid (1 : 400). The percentage decline in the nymphal population 48 hours and one week after spraying was noted down and analysed statistically. It was observed that 48 hours after treatment parathion was significantly better than endrin and endrin was superior to pyrocolloid. The percentage of decline in the nymphal population in the plots treated with pyrocolloid was significantly higher than in the plots untreated. One week after treatment it was observed that the percentage decline in nymphal population in the plots treated with parathion and endrin respectively was significantly higher than in the plots untreated and the plots treated with pyrocolloid. The parathion and endrin were about equally effective and significantly superior to pyrocolloid.

75. Preliminary studies on control of Tikka disease of groundnut with spray fungicides.

N. N. MOHANTY and B. C. BEHERA, Bhubaneswar.

A susceptible, late maturing variety 'Pondichery' was selected. The experiment was replicated three times in a compact randomised block with the following treatment: Bordeaux mixture 4 : 4 : 50, 0.16% wettable sulphur, 0.3% Cupravit, 0.3% Blitox 50, 0.2% Dithane Z-78, 0.3% copper sandoz, 0.3% cuprous oxide and control. Incidence of disease and yield of individual plots were recorded.

The incidence of disease was the least in case of Bordeaux mixture. Blitox, Cupravit and cuprous oxide were also found to be equally effective in reducing the incidence of disease. From the average yield figures of individual plots, it was found that the best control of disease was effected by five sprayings of Bordeaux mixture which resulted in 100% increase in yield over the untreated. Cupravit, copper sandoz, cuprous oxide and Blitox were also found to be effective in controlling the disease, resulting in more than 52% increase in yield. Out of the fungicides tried, Dithane and wettable sulphur were least effective. The results were statistically significant.

76. Tedion, a new acaricide for control of red spider mite on tea.

T. D. MUKERJEA, Tocklai

The acaricidal properties of Tedion V-18-2, 4, 5, 4-tetrachloro-diphenyl sulphone have been examined and compared with those of Akar 338 and standard lime sulphur against red spider mite *Oligonychus coffeae*. Tedion is ovicidal when sprayed directly on the eggs or eggs laid on dry deposit. The eggs which were laid on the dry deposit were more susceptible than the ones which were directly sprayed. Tedion sprayed directly on females affects the eggs developing in the ovary. Most of the eggs laid on untreated leaf shoots during the first five days

by females previously exposed to Tedium were sterile. After this period proportion of viable eggs increased and after eight days the effect of Tedium was practically lost.

Tedium V-18 has got a limited contact poison effect on the adults and nymphs.

Experiments carried out on potted plants to evaluate the comparative efficacy of Tedium, Akar 338 and lime sulphur, it was found that Tedium showed little effect within 24 hours of application, but progressively the rate of kill increased and at the end of 28 days it produced significantly higher mortality than Akar 338 and standard lime sulphur.

77. Terpene Series -V- Experiments in the preparation of insecto-fungicides.

R. U. ALI KHAN and K. C. GULATI, New Delhi.

A single chemical combining insecticidal and fungicidal properties may be better in plant protection than the conventional insecticides and fungicides. With this end in view, experiments were performed for the preparation of thiocyanates based upon delta-3-carene, present to the extent of 40-60% in Indian turpentine oil *ex. Pinus Longifolia*. The presence of -N-C-S group in organic thiocyanates is known to impart insecticidal and fungicidal properties.

Terpenes are known to produce narcosis because of their architectural built up and high reactivity. Therefore, they should provide suitable raw material for the introduction of toxophore, Δ^3 -carene containing cyclopropane ring and having somewhat of structural similarity with pyrethroids.

78. Persistence of DDT as soil insecticide.

S. P. DUGGAL, R. S. DEWAN and K. C. GULATI, New Delhi.

Due to the apparent stability and unusual potency of DDT, the question immediately arose as to whether its prolonged and repeated use on crops and in soils might result in the accumulations of harmful residues in fields receiving DDT dusts or sprays for insect control. This was studied in field soils where sugarcane, chillies and wheat were grown. Before sowing, the soil was treated at the rate of 0, 5, 10 and 15 lbs. of technical DDT per acre. Each treatment was replicated four times in 48 randomized blocks.

Soil samples taken at sowing (immediately after the treatment) and at harvest time were analysed for micro-quantities of DDT at 0-3", 3-6" and 6-9" level, by the method of Schechter and Haller. At harvest time DDT disappeared completely from the soil supporting sugarcane, while there was only about 50 and 20 per cent disappearance from those supporting chillies and wheat respectively. The rate of degradation was attributed to the duration of crop and weathering conditions.

There was no contamination of DDT from soil to plant materials at harvest time. No significant effect of DDT on crop yield was found.

79. Contact effect of different insecticides on the grubs of *Oryctes rhinoceros* L., a serious pest of coconut.

S. PRADHAN, M. G. JOTWANI, PRAKASH SARUP, New Delhi and
G. C. SEN GUPTA, Orissa.

Advanced stage grubs of coconut beetle, *Oryctes rhinoceros* L. (Scarabaeidae : Coleoptera) regularly collected by one of the authors (Sen Gupta) from Orissa were utilized for the present investigation. Due to large size of the grubs these were

kept singly in Petri dishes and were sprayed directly under Potter's tower. The sprayed grubs were kept for drying of the insecticides for about 10 minutes and then transferred to small glass jars containing dung and soil. These jars were placed in a controlled temperature room at $27^{\circ}\text{C} \pm 1^{\circ}\text{C}$. Mortality counts were taken seven days after the treatment. Endrin, dieldrin, chlordane and toxaphene did not give any kill even at as high a concentration as 1.0%. The highest mortality obtained with different concentrations in the rest of the insecticides tried was 75% with (i) gamma BHC (0.25%), (ii) parathion (0.25%), (iii) p, p' DDT (0.5%), (iv) aldrin (1.0%) and (v) isodrin (1.0%); 50% with malathion (0.5%) and only 25% with diazinon (0.5%). Although these observations are yet of a preliminary nature, they afford a guidance that the insecticides which have proved to be altogether ineffective need not be tried in costly and laborious field experiments.

80. Use of polythene (polyethylene) film in grain storage structures.

S. PRADHAN, P. B. MOOKHERJEE and G. C. SHARMA, New Delhi.

In recent years the use of polythene film as a packing material has increased. Initial observations made with the different grades of the polythene film have shown that at least for storage of wheat a film of 0.007" thickness is sufficiently moisture proof. An attempt has been made to incorporate film of 0.007" thickness within the body wall of an earthen storage structure to study the infestation in the grains stored in it. This is to combine the mechanical strength of the mud structure with the comparatively more effective imperviousness of the polythene film to vapours and gases.

It has been observed that about one and a half maunds of wheat could be kept in very good condition with practically no infestation in this type of improved structure for one year compared with an infestation up to ninety per cent in control.

An initial fumigation with carbon tetrachloride was also given to wheat before sealing it in this type of improved structure and the results were similar as in the previous case. There is some indications that the storage pests would not breed in this type of improved storage structure. The moisture content of wheat was less when stored in this type of improved structure than in the control.

81. Dagger nematodes, *Xiphinema* spp., attacking fruit trees in Uttar Pradesh.

M. RAFIQ SIDDIQI, Aligarh.

The importance of dagger nematodes, *Xiphinema* spp., in agriculture has been discussed. It is stated that the majority of *Xiphinema* species of Uttar Pradesh are parasites of trees. Their occurrence in sufficiently large numbers around roots of lemon, orange, mango, pear and some other trees denotes their importance as a source of danger to fruit trees. Hosts and geographical distribution of five species namely *X. americanum* Cobb, 1913; *X. indicum* Siddiqi, 1959; *X. basiri* Siddiqi, 1959; *X. brevicaudatum* Schuurmans Stekhoven, 1951; and *X. citri* Siddiqi, 1959, have been discussed. A sixth species, *X. pratense* Loos, 1949, hitherto known only from Ceylon, has been reported to occur in hilly areas of Banda district in U.P. Besides their previously reported distribution, *X. americanum*, *X. indicum* and *X. brevicaudatum* have been found in various hill stations including Naini Tal, Ranikhet, Bhimtal, Bhowali and Almora. New host records include the following: *X. indicum*—*Prunus armeniaca* L. and *Pyrus sinensis* Lindl; *X. citri*—*Tamarindus indica* L. and *Eugenia jambolana* Lamk; *X. pratense*

—*Carissa* sp.; *X. americanum*—*Malus sylvestris* (L.) Mill. and *Pyrus sinensis* Lindl.;
X. basiri—*Citrus reticulata* Blanco.

82. A note on the stunted disease of ramie—*Boehmeria nivea* Gaud. *

N. DUTT and B. C. KUNDU, Barrackpore.

Phenacoccus hirsutus Gr. has been recorded during 1957 as causing stunted disease of ramie (*Boehmeria nivea* Gaud.)—textile fibre plant of great commercial value. Since then its incidence is gradually increasing. Apical portion of the plant is attacked and stuntedness is induced by arresting the linear growth of internodes. Swelled and shortened internodes gives a 'bushy' appearance. Petioles of the leaves arising from the affected region swell particularly at the basal region and become shortened while the lamina in most cases becomes irregularly crumpled. The internodal length of the affected portion of the stem becomes 1/7th of the normal and it swelled nearly two times.

Infestation tests produced the stunted disease of ramie and the typical 'bushy' symptom after 9 days from infestation with newly hatched nymphs.

As the pest was also reported from the fibre crop—*Hibiscus sabdariffa* (roselle) allied to jute, a number of cross infestation was given to roselle with just hatched nymphal stage of the insect bred on ramie. The typical bushy symptom could be produced in roselle after about 9 days.

Hypertrophy of cells of all the tissues in radial direction and reduced lignification seem to be the general feature of the internal anatomy of the affected stem. Besides, the cell layers in the different tissues also increase in number.

83. Study of the diseases of *Piper betle* in Banaras district.

SUSHIL KUMAR BHATTACHARYYA, Calcutta

The disease which commonly occurs in the vine-yards in the district of Banaras were surveyed and studied with particular reference to their symptoms, morphological character and pathogenicity. Experiments were conducted with chemicals to find out some measures to check the diseases which sometimes cause epidemic resulting a total loss of the crop.

The following diseases were noted to occur on *Piper betle*: (1) anthracnose caused by *Colletotrichum piperina* and *Gleoesporium cingulata*, (2) foot rot and spot caused by *Phytophthora parasitica* Dastur and (3) foot rot caused by *Rhizoctonia solani* Kuhn. 2% formaline or 1% Borduax mixture when used as soil drencher, gave satisfactory check against the foot rot caused by both *P. parasitica* and *R. solani*. As spray chemicals 2% copper carbonate, 1% Borduax mixture, and 1% quinone acted satisfactorily against anthracnose caused by *C. piperina*, *C. cingulata* and leaf spot caused by *P. parasitica*. 1% Borduax mixture, in general, gave satisfactory result against all the diseases, as a spray and a soil drenching chemical.

84. *Achaea janata* as a pest of ripening guavas.

B. K. SRIVASTAVA, Udaipur.

Moths of the castor semi-looper, *Achaea janata* Linn. present a serious problem in the successful production of guavas in the region south-east of Arravalis in Rajasthan. The moths have been for the first time observed to puncture the

ripening guavas, causing the fruits to collapse. Juicy pulp is drawn by means of the probocits. The seats of injury soon become brown. The attacked fruits rot within a day and fall from the trees. They are rendered unfit for human consumption. This quick destruction is possibly on account of fungus and bacteria. The moths have been frequently noticed to feed on the fallen and fermenting fruits which serves as a source of infection.

Varieties of guavas having hard and compact built are severely affected which form the major crop of guavas in this region. Moths become active from the dusk and continue feeding throughout the night. Dark and calm nights are very favourable for the activity of the moths. They are usually not frightened by the ordinary physical disturbances including lighting of the battery torches on them. All attempts of control by poison baiting, light trapping and using attractants, usually recommended for control of fruit sucking moths, have proved unsuccessful.

85. Effect of relative humidity on germination of chlamydospores of *Ustilago Scitaminea* Syd.

S. K. SAXENA and ABRAR M. KHAN, Aligarh.

Effect of relative humidity on the germinating of chlamydospores, obtained from Aligarh, Punjab, Poona, Bengal, Bihar, Coimbatore and Cuddalore, has been studied at four different temperatures. At 25° and 30°C, which are optimum for germination for all the collection, the percentage germination is almost equivalent to the germination in water at these temperatures. With the fall of relative humidity from 100 to 90 per cent, there is corresponding decrease in the percentage germination. At temperatures other than optimum for germination (15° and 40°C) there is very little germination even at 100 per cent relative humidity and no germination all at 98, 94, and 90 per cent relative humidity.

The different collections also respond differently.

PLANT BREEDING AND GENETICS

86. Experiments in the production of better rice strains.

M. N. RUDRA, Patna.

A crystalline substance, still unidentified, seems to exert an influence in promoting an overall better growth of paddy seedlings when they are soaked, before embedding, in a solution containing 1 ug/ml. of this substance.

87. Interspecific hybridization between *Corchorus olitorius* Linn. and *C. capsularis* Linn. and the cytogenetical basis of incompatibility between them.

G. I. PATEL, Baroda and R. M. DATTA, Calcutta.

The pollen grains of *olitorius* and *capsularis* germinate within ten minutes in cross as well as in self-pollination. The rate of growth of the pollen tubes of one species into the styles of the other is slower compared to that in self-pollination. Pollen tubes are found in the embryosacs of most of the ovules within 24 hours in case of self-pollination. In cross-pollination, the tubes are observed in the

embryosacs of only a few ovules which are located at the upper part of the ovaries after 2-4 days. Only a few ovules, particularly those situated at the upper part of the ovaries, are fertilised. Almost all the ovules in the lower half were in a collapsed condition; no pollen tubes were noticed in their micropyles nor in the ovarian tissue nearby.

In both the species, styles vary a great deal in length. *Capsularis* styles are usually shorter than *olitorius*. Variation in style length does not interfere in crossing these species.

Several hundreds of flowers of different *capsularis* types were pollinated with those of *olitorius* and *vice versa* for three years. The setting of pods is observed in practically all the crosses but it varies greatly in different crosses including reciprocal ones. A large number of the set pods sheds in course of their development mostly within fifteen days after pollination. Cross-pods grow slowly than the selfed ones. Mature cross-pods vary much in their size; the largest ones obtained in different crosses are smaller than the selfed ones.

Very small quantity of seeds are produced in cross-pollination compared to self-pollination. Most of them are shrivelled and empty. Few apparently normal-looking one, of the same size as in selfed, weigh less than the same number of selfed seeds. This suggests the under-development of the embryo or/and endosperm. The seeds do not germinate. No hybrids between the two cultivated species of jute have been obtained. Such reduction methods also fail. The possibilities of getting hybrids between them through embryo culture are indicated.

• 88. Preliminary study on the rate of pollen tube growth of *Sesbania aculeata* Pers. under infra-red radiation in culture medium.

S. K. SEN and R. M. DATTA, Calcutta.

The rate of pollen tube growth per hour of *Sesbania aculeata* Pers. under the infra-red rays was slower than the rate of pollen tube growth per hour under day light. When the infra-red rays were offered in combination with normal light or *vice versa*, in no case the rate of pollen tube growth per hour surpassed the rate of pollen tube growth per hour, under day light during the 4 hours' phase of growth.

89. Interspecific hybridization between *Corchorus sidoides* F. Muell. and *C. siliquosus* Linn.

R. M. DATTA and S. K. SEN, Calcutta.

In cross between *Corchorus sidoides* and *C. siliquosus* the pod set was 19.05 per cent and the percentage of pod harvested (out of set pods) was 100 per cent. All seeds out of these harvested cross pods were non-viable. In cross between *C. siliquosus* and *C. sidoides* the pod set was 8.7 per cent and the percentage of pod harvested was 100. As in the above case, the seeds were non-viable.

The genus *Corchorus* has got species which are widely related. The possibility of getting viable hybrids in this case is impossible as the phylogenetic relationship does not allow to set viable seeds when they are crossed each other. The karyotypic study of the natural polyploid species, *siliquosus*, will throw light on this aspect and the breeders will then get a tool for handling this subject.

90. Comparative studies on the rate of pollen tube growth *in Vitro* and the mitotic rate of division of the generative cell in the pollen tube of 4n *Corchorus olitorius* Linn. Strain C.G. and its diploid.

R. M. DATTA and S. N. BANERJEE, Ccutta.

(1) the tube nucleus generally precedes the generative cell; sometimes follows the latter; (2) the generative nucleus contains chromatin matters of different sizes; (3) Chromosomes divide equationally and no cell plate formation of the spindle is discernible; (4) spindle may lie longitudinally or transversely and also slanting with reference to the longitudinal axis; (5) a tendency of eliminating extra chromosome or chromosomes is observed; (6) anaphase separation shows irregularity in the movement of individual chromosomes, though regular movement is also observed; (7) unequal distribution of chromosomes is observed; (8) in one long generative cell some cast-out chromosomes have been found dividing in two groups in addition to the original division of the nucleus. All are in metaphase stages suggesting that ultimately six sperms of varying sizes will be formed; (9) clear spindle is formed; (10) cytokinesis takes place by furrowing; (11) in one case two tube nuclei are observed in addition to one small metaphase division suggesting the ultimate formation of four nuclei of varying sizes; (12) comparative studies on the rate of growth of pollen tube show that 4n materials show less growth than 2n materials. After 3rd hour 4n tubes burst whereas 2n tubes continue growth slowly.

91. Sex differentiation in maize.

R. N. MOHANTY, Bhubaneswar.

In a variety Amarillo-de-cuba, an open pollinated exotic variety, certain deviations in the formation of tassel and cobs were recorded. They are: (i) The entire tassel was modified into a 'multiple cob', with a central big cob, and fifteen slender finger cobs. The cobs were allowed to set seed, by hand pollinating the silk with pollen from another hermaphrodite normal plant. The seed formation was normal in the cobs. The seeds were however of slightly smaller size than the normal grains of that variety. (2) In another plant, the male inflorescence carried a cob on the central main rachis. The lateral branches carried the normal male spikelets. (3) In a plant of the single cross (FXC) obtained from the Punjab, there was a small cob formed in the bottom portion of the main rachis of the panicle, borne terminally with the male spikelets on its top. The laterals in this case carried the male spikes. The seed setting was normal in both the cases. These deviations are supposed to represent the different phases of transition from hermaphroditism to absolute dioecism in maize.

92. On Estimation of Gene Numbers.

S. N. SEN, Patna.

Considering the additive modal with dominance, as described by Gisher *et al.* and Mather, and assuming that linkage is absent, the moments obtained from the backcross data may be expressed as the linear functions of the genetic parameters like, d , h , dh , etc.

Wright, Mather, Panse and others have given formula for estimating n , the number of controlling genes. It has been shown that if the backcross data are available from both the parental crosses, then another simple estimate of the number of controlling genes may be worked out conveniently.

Following the procedure suggested by Robson, the lower bounds superior to n , has also been constructed.

93. **Studies in the Essential Oil-yielding Plants of India. V. A comparative study of the growth of 'Diploid' and 'Polyploid' plants of *Ocimum Kilimandscharicum* Guerke raised at different regions of West Bengal and the yield of raw material (leaves) for extraction of Camphor and Camphor Oil.**

T. K. CHOUDHURY and R. B. BOSE, Calcutta.

The method employed for the induction of polyploidy by colchicine in *Ocimum kilimandscharicum* Guerke has been reported by the author. Since then both the diploid and the polyploid plants were multiplied and raised from seeds at Sukna (dist. Darjeeling), Haringhata (dist. Nadia) and Calcutta during 1956-57 to measure their rate of growth and yield of leaves for extraction of camphor and camphor oil.

The rate of germination of the seeds varied from 75-80% in diploid and from 60-70% in polyploid. Flowers appeared in diploid in November after about six months from germination and flowering continued for six months upto April in the following year. In polyploid flowers appeared 30-40 days later and flowering continued for nearly nine months upto the following September.

Polyploid plants were found to be taller at all the stations with different edaphic and climatic conditions and the quantity of leaves (the raw material for extraction of volatiles) produced by them was about 2-3 times the quantity produced by the diploid plants. Polyploid plants also gave the better yield of leaves for a longer period.

GENERAL

94. **Some interesting feature in the root anatomy of *Borassus flabellifer* L.**

BINA DUTTA, Haringhata.

Occurrence of persistent velamen of 4-5 cell layer thick is a peculiar feature in the root of *B. flabellifer*. Cortical parenchyma is traversed by large number of air cavities, a peculiar character of *Borassus* root. Large number of scattered sclerenchyma bundles associated with air cavities in the parenchyma is a mixed character of xerophyte and hydrophyte.

Sclerotic pith and large number of xylem and phloem bundles recall that of arboreal Liliaceae. In many respects the anatomy resembles both Liliaceae and Araceae. So Liliaceae may be presumed ancestor of Spathiflorae from anatomical consideration.

95. **Use of mechanical bird scarer in minimising damage by birds to apple fruits.**

K. M. GUPTA, Chaubattia.

At Chaubattia (29°45' : 79°40') the common birds damaging apple fruits during July-August 1958-59 were *Pycnonotus leucogenus* Gray, *Megalaima vitiensis* Boddart. and another locally known as *Bansaria*. In spite of canister beating for scaring away birds, the percentage of bird damaged fruits was 17.7 and 13.3 for 1958 and 1959, respectively. But the use of Purivox mechanical bird scarer during the same period working nine hours a day, consuming 20 ounces of calcium carbide and producing 125-150 loud explosions per day, a single machine on an area of 7½ acres

reduced the percentage of bird damaged fruits to 5.37 and 5.2, respectively, resulting in a net saving of Rs. 100 to 125 per acre. The noise level of explosions was found to be 128, 120, 112, and 100 decibels at distances of 16, 29, 60 and 125 meters, respectively. The effective range of the machine was 30 yards under hill conditions. Birds acquired temporary immunity to explosions, however, the machine continued to remain effective for more than 6 weeks.

96. Toxic effect of "Hivar" pods (*Acacia leucophylla*) on sheep and goats.

B. M. PATEL, V. V. MISTRY and P. C. SHUKLA, Anand.

Sudden deaths of some sheep and goats due to heavy grazing on *hivar* pods were reported from Nagpur. As the postmortem examination of carcass did not reveal any pathological changes in any organ, poisoning due to some toxic principle in *hivar* pods was suspected.

Hivar pods are quite similar to *babul* (*Acacia arabica*) pods and were analysed for their nutrients as well as for HCN contents. These indicated that though *hivar* pods having more than 15% protein, 55% N.F.R. and 1% calcium are quite nutritious, the high HCN content of 40 mg. per cent and the high sulphur content to the extent of 1% are supposed to have been the causes of the sudden death of animals.

97. Acidity function measurements in ethylene glycol and ethylene glycol water mixtures.

CH. KALIDAS, Calcutta.

The acidity function is an extension of the familiar method of determining the hydrogenion concentration of a solution by colorimetric methods. The function, as developed by Hammett, on the basis of the equation— $B + H^+ \rightleftharpoons BH^+$ —is given by

$$H_0 = pk_{BH^+} - \log \left(\frac{C_{BH^+}}{C_B} \right)$$

where pk_{BH^+} is the thermodynamic ionisation constant of the conjugate acid of an uncharged basic indicator, B, and C_{BH^+}/C_B is the ratio of the concentrations of the conjugate acid, BH^+ and the indicator base, B which have different regions of spectral absorption. The above equation is equivalent to

$$H_0 = -\log \left(\frac{a_{H^+} f_B}{f_{BH^+}} \right)$$

where a_{H^+} is the activity of the hydrogen ion in the solution and f_B and f_{BH^+} are the activity coefficients of the indicators base and its conjugate acid, referred to a value of unity in an infinitely dilute solution in water. Similar functions have been derived for the negatively and positively charged indicators.

The generality of the H_0 function is well established in water and H_0 values for many acids are available in this medium. The present abstract concerns with its applicability to non-aqueous media, particularly in ethyleneglycol and ethyleneglycol water mixtures. H_0 values have been determined for hydrochloric acid in ethyleneglycol upto 2M and for hydrochloric and perchloric acids upto 4M in a 1:1 (vol/vol) mixture of ethyleneglycol and water with the three indicators, p-nitroaniline, o-Nitroaniline and 4 chloro-2 Nitroaniline. Their utility is discussed in the slight of the values derived for other non-aqueous media.

98. Heats of mixing of binary liquid mixtures—Systems nitrobenzene, benzene, ethylbenzene and cyclohexane.

A. V. ANANTARAMAN, S. N. BHATTACHARYYA and Miss ASOKA MUKHERJEE, Calcutta.

The heats of mixing of the systems nitrobenzene+benzene; nitrobenzene+ethylbenzene and nitrobenzene+cyclohexane are reported. All the systems were measured at 40°C in a calorimeter capable of measuring very small heat changes of the order 0.002J/mm. sensitivity. All the three systems give positive heats of mixing represented by the equations—

nitrobenzene—benzene—

$$h^{\circ} / x_1 x_2 = 1099.9 - 10.76(x_1 - x_2) + 222.9(x_1 - x_2)^2$$

nitrobenzene—ethylbenzene—

$$h^{\circ} / x_1 x_2 = 1103.9 - 186.3(x_1 - x_2) - 222.5(x_1 - x_2)^2$$

nitrobenzene—cyclohexane—

$$h^{\circ} / x_1 x_2 = 6433 - 2096.3(x_1 - x_2) + 2052.5(x_1 - x_2)^2$$

99. Cold mastication of rubber.

ASHIM KUMAR GHOSH and ANIL K. SIRCAR, Calcutta.

Mastication of rubber in air and nitrogen was carried out for different periods at 18°C in an internal masticator of the type designed by Watson at B.R.P.R.A. The results of viscosity measurement carried out with the masticated samples show that the breakdown in nitrogen is much less than in air which go to confirm the mechanism of cold mastication put forward by Watson.

100. Application of differential thermal analysis in ebonite reaction.

M. L. BHAUMIK and ANIL K. SIRCAR, Calcutta.

The method of differential thermal analysis has been applied to the study of exothermic heat evolution of ebonite reaction. In comparison to the other methods so far studied this method gives a fuller picture of the reaction in the complete temperature range (50—300°C). Effects of accelerators and other compounding ingredients on the exothermic heat, if any, can also be determined by this method. Preliminary results show that prior to the main exothermic reaction there is an endothermic reaction which has been explained as due to the transition of α to β sulfur. It has also been seen that there is another endothermic reaction of sulfur with fully cured ebonite at a higher temperature when this is taken as reference material, while with alumina this latter reaction is absent. Accelerators move the initiating temperature to the side of lower temperature.

101. Determination of unsaturation in vulcanised rubber.

D. BANERJEE and ANIL K. SIRCAR, Calcutta.

A method has been proposed for the determination of unsaturation of vulcanised rubber. The method consists in estimating the halogenated product formed (both insoluble and soluble) and finding out the amount of sulphur displaced by the

reagent (ICI). The iodine absorption is then found out by determining the actual gain in weight by halogenation after deducting the amounts of sulphur displaced, converting this weight to the equivalents of iodine and deducting from this the iodine equivalent of the amount of sulfur displaced. The results of unsaturation measurements obtained by this method suggest different types of reactions in soft rubber and hard rubber (ebonite) vulcanisation.

102. The influence of ultrasonic waves on ferric phosphate and ferric arsenate solutions.

ASHIM KUMAR GHOSH, Calcutta.

The influence of ultrasonic waves of frequency 2.1 Mc/s and power 225 watts per sq. cm. was observed on the solutions of ferric phosphate and ferric arsenate after they have been set to a gel. The gelation time of the exposed solution is found to increase than the unexposed one. This delay is attributed to the destruction of hydration layer of strongly hydrated particles due to cavitation.

103. Short route to carcinogenic hydrocarbons.

BISWAJIT SINHA, Calcutta.

The biological importance of 3:4-benzpyrene arose in connection with the view that the carcinogenic action of polycyclic hydrocarbons is associated with metabolic oxidation at specific molecular centres. As a consequence a series of publications have appeared during the last few years on the synthesis of 3:4-benzpyrenes with methyl group at different positions in the ring. A short method of synthesis of 3:4-benzpyrene is given. This method is a general one and has got wide applicability.

Ethyl cyclohex-1-keto-6-acetate-2-carboxylate which has been obtained through ring opening and recyclisation of the condensation product from ethyl-cyclohexanone-2-carboxylate and ethyl chloroacetate is condensed with β -naphthylethyl bromide. This was hydrolysed with hydrobromic acid—acetic acid mixture to the keto acid and this has been cyclised with polyphosphoric acid to the hydroxy compound. This was dehydrogenated to 3:4-benzpyrene.

104. Morphogenetic studies of leaves of some varieties of rice plant (*Oryza sativa* L.).

B. SAHA, Barrackpore.

On the basis of normal harvesting time and on certain morphological and physiological aspects, paddy varieties are classified into three agriculture groups—Aus (autumn), Aman (winter), and Boro (spring). Although different vegetative characters are taken into consideration for differentiation individual varieties and strains, the ratio of the length of leaf sheath to that of leaf blade (S/B) has not been given much importance. In order to determine how far these ratios are constant, *Satica* (Aus), *F.R. 13A* (Aman) and *Boro* have been used.

The S/B ratio is usually more than unity in the first laminate leaves of the main culm in *Satica* and *Boro* and slightly less in *F.R. 13A*. but such ratios in the successive later-formed leaves in all the three varieties are far less than this. The graphical representation of the relative lengths of sheath and blade and of the sequence of S/B ratios in *Satica*, *F.R. 13A* and *Boro* show a significant distinc-

tion among one another and thus helps in estimating the normal growth and in predicting the phases of important developmental stages.

105. Investigation to determine sources of pollution and their effects on the increase of chlorine demand of filtered water.

R. K. SEN, Barrackpur.

Chlorine demand, chlorides, hardness, iron, manganese, nitrites and nitrates of river water, settling tank (inlet), settling tank (outlet) and filtered water samples have been determined. It has been observed that the higher concentrations of dissolved salts bring about over turning in settling tank. This is followed by a change in nature and quality of settling tank (outlet) sample and its effect on filtration. Formation of iron-organic complex is noticed. Accumulation of this iron-organic complex on the sand filters may have some effect in suppressing microbiological activity which takes place during slow sand filtration. Chemical decomposition of accumulated organic matter may take place with the formation of some acids and its ultimate leaching as Na-salt.

106. Flavour restoration in Mandarin orange concentrate.

J. S. PRUTHI, N. S. S. RAO, and GIRDHARI LAL, Mysore

The natural flavour of orange juice, which is mostly due to the presence of volatile essential oil, is lost during the process of vacuum concentration. Experiments conducted to determine the optimum level of fortification of mandarin orange concentrate or reconstituted juice with freshly extracted orange peel oil have been presented. Flavour evaluation of fresh and reconstituted juices was done by a selected panel of judges according to Hedonic Scale. The data obtained were statistically analysed.

Results indicate that, unlike Valencia orange juice concentrate, addition of orange peel oil to the reconstituted Coorg Mandarin orange juice is very essential. The optimum levels of fortification of oil to the reconstituted mandarin orange juice and four-fold concentrate were 0.02 and 0.08% v/v respectively. The addition of 'Palatone' at the rate of 100 p.p.m. did not significantly improve the flavour of the concentrate or the juice reconstituted therefrom.

107. Some technological aspects of manufacture of Mandarin orange concentrate.

J. S. PRUTHI, N. S. S. RAO and GIRDHARI LAL, Mysore.

Detailed physico-chemical changes in Coorg Mandarin orange juice during commercial scale vacuum concentration in a forced-circulation evaporator (fabricated at the Institute) have been studied and discussed. The various aspects covered are heat-transfer co-efficient and changes in °Brix, acidity, pH, viscosity, true ascorbic acid, carotene, colour, etc.

The co-efficient of heat-transfer during vacuum concentration of mandarin orange juice ranged between 200-300 Btu/hr. sq. ft. °F., depending upon the initial pulp content and viscosity of the juice employed. The percent losses in carotene and ascorbic acid during concentration were of the order of 4.6 and 9.3 per cent respectively. The orange juice retained most of the nutrients during concentration and had an attractive appearance, but it somewhat lacked in natural flavour of the parent juice. However, the normal flavour could be restored by the addition of 0.02% of freshly extracted orange peel oil to the juice reconstituted from the concentrate.

108. Studies in the dehydration of guava for the subsequent recovery of pectin during off season.

J. S. PRUTHI, K. K. MOOKERJI and GIRDHARI Lal, Mysore.

The conditions of dehydration of guava for recovery of pectin during off-season have been studied. The results of the determination of the critical temperatures of dehydration, by following up the recovery and stability of pectin have been presented. The losses in the yield and quality of pectin recovered during storage at different temperature have also been studied.

From the view point of recovery and quality of pectin, the optimum temperature of dehydration of guava slices was found to be 150°F, the critical temperature being 160°F. It took about 9 hours to dehydrate to 4.0% moisture. The dehydration ratio was about 4.8. The rehydration ratio was 3.5. Blanching prior to dehydration had a slight beneficial effect on the quality of pectin, probably due to leaching away of impurities. Addition of poly-phosphates @ 2.5% increased the recovery of pectin.

As judged from the pectin recovery, methoxyl content and anhydrouronic acid, dehydrated guava could be kept at 5-7°C for about 7 months without any material loss. At room temperature, the losses were slightly more, but at 37°C, considerable deterioration took place during 7 months' storage.

109. Changes in the quality and recovery of pectin from fresh guava during its refrigerated and common storage.

J. S. PRUTHI, K. K. MOOKERJI and GIRDHARI LAL, Mysore.

The physiological losses in weight and the changes in total pectin, water-soluble, oxalate-soluble and acid-soluble pectin in guavas picked at 2 stages of maturity (fully developed green and yellow) stored at 47-50°F (relative humidity 85-90%) and at room temperature (20-28°C) have been reported.

The physiological losses in weight of green guavas stored at room temperature for one and two weeks were 18.8 and 20.2% respectively, whereas the corresponding losses in weight during refrigerated storage were 3.9, 6.8, 9.9 and 12.0% after 1, 2, 3 and 4 weeks' storage of green guavas respectively. The losses in weight of yellow guavas were comparatively higher.

At room temperature, the quality of pectin (as judged from methoxyl content and anhydrouronic acid content) deteriorated very rapidly (within 1 week), more so in the case of yellow fruits. The water-soluble and oxalate soluble pectin increased both in green and yellow fruits, (the increase being greater at room temperature), whereas the acid soluble pectin decreased. From the viewpoint of recovery and quality of pectin, fully developed green or yellow guavas could be kept at 47-50°F for 4 weeks. At room temperature, guavas could hardly be kept for a week.

110. Some technological aspects of dehydration of Garlic : Determination of the critical temperature of garlic for dehydration.

J. S. PRUTHI, L. J. SINGH and GIRDHARI LAL, Mysore.

Based on data on the retention of antibacterial activity, allicin, allyl sulphide, colour and flavour in fresh and dried garlic flakes during dehydration at different temperatures ranging from 30°C to 70°C, the critical temperature for dehydration of garlic has been reported to be 60°C. It has, therefore, been suggested that the product temperature during dehydration of garlic should be lower than 60°C.

111. Effect of various factors on the stability of the anthocyanin pigment in passion fruit skin (*Passiflora edulis* Sims.).

J. S. PRUTHI, R. SUSHEELA and GIRDHARI LAL, Mysore.

The effects of various factors such as temperature, oxygen, pH, ascorbic acid, tannic acid, thiourea acid, thiourea and hydrogen peroxide on the stability of the anthocyanin pigment (Pelargonidin 3—diglucoside) naturally occurring in passion fruit skin (*Passiflora edulis*, Sims.) have been studied with a view to elucidate the mechanism of degradation of the pigment during refrigerated and common storage of the fresh fruit.

Storage studies demonstrated that : (1) ascorbic acid in the presence of oxygen accelerates the deterioration of the pigment, (2) thiourea decreases the rate of destruction of ascorbic acid, this indirectly preventing the rate of anthocyanin losses, (3) tannins have a stabilizing effect on the pigment, (4) pH had a very significant effect on the stability of the pigment. The pigment faded and changed in hue as the initial pH of 2.0 was raised to 3.4 and above, (5) while studying the effect of temperature, it was observed that at 5-7°C, the pigment was quite stable for about 3 days, but at 55°C, the degradation of the pigment was noticeable even within 24 hours' storage, indicating that temperature had a deleterious effect on the pigment and (6) hydrogen peroxide, likewise, had a destructive action on the pigment.

112. Effects of the interruption of destruction of apical dominance by plant regulation sprays in cowpea (*Vigna sinensis*)

B. CHOUDHURY and RAMPHAL, New Delhi.

The cowpea (*Vigna sinensis*) is an important summer vegetable crop. Plants of cowpea variety, *Pusa barsati*, were sprayed with maleic hydrazide (50, 100, 200, 400, 600 and 800 ppm) and sodium azide (100, 200 and 400 ppm). Apical dominance was interrupted with all concentrations of MH-30 and SA. MH-30 (800 ppm) completely destroyed the apical dominance. The increase in the number of lateral shoots was more pronounced in the case of secondary branches than the primary ones. MH-30 (50, 100 and 200 ppm) significantly increased the yield of pods per plant. Higher concentrations of MH-30 proved toxic and reduced the pod yield. SA, at all concentrations was ineffective so far as the yield of pods is concerned. There was no significant effect of the sprays on the size or viability of the seeds. The maturity of the pods was delayed by about a week as a result of the plant regulator sprays. It is concluded that the number of lateral shoots forced up, as a result of the interruption or destruction of apical dominance, is not directly related to the yield of pod plant. The concentrations of the plant regulator sprays used is more important in affecting the yield of pod per plant.

113. Studies on the nutrition of oilseed crops. IV. Effect of phosphorus and sulphur on the uptake of nitrogen and growth yield and oilcontent of sesame (*Sesamum indicum* Linn.).

P. K. SEN and A. LAHIRI, Calcutta.

Results of an experiment on the effect of phosphorus and sulphur deficiencies on the uptake of nitrogen and on growth, yield and oilcontent in sesame (*Sesamum indicum* Linn.) Var B-14 conducted in the sand culture are presented.

Phosphorus deficiency has produced the characteristic deeper green colour of leaf, stunting in growth, severe reduction in dry matter, adverse effect on size and

shape of leaf, floral development, seed formation, and root growth. No deficiency effect on oil content has, however, been noted.

Under sulphur deficiency leaves are lighter green in colour but there are no adverse effect found on size and shape of leaf or on floral development. Yield of dry matter has, however, been appreciably reduced although the reduction is much less in comparison with that shown under phosphorus deficiency.

Nitrogen uptake decreases under phosphorus deficiency as well as under sulphur deficiency but the decrease is relatively more severe under phosphorus deficiency.

Phosphorus deficiency shows an adverse effect also on sulphur content of the plant but sulphur deficiency has no such effect on phosphorus content on the other hand, sulphur deficiency indicates a tendency towards increasing the uptake of phosphorus.

114. Some ideas on soil suitability classification of orchard.

K. C. BHATTACHARYYA, Calcutta.

The detail classification of Orchard is rather difficult. The starting point is very detail Soil Survey. Land classification based on detailed soil maps is the most important activity of Soil Survey groups in relation to application and at the same time its touchstone. In several countries a distinction is made between the systematic soil map and surveys for special purposes. It should be borne in mind that climate is as important or even more important than soils in respect to the suitability of a certain spot for certain purposes.

The type of work should be taken up in a district where the crop in question is grown on a large scale. It will soon be noticed that the crop produces more on one field than on another. The difference may be apparent in the yield, quality of the produce, age of orchard, variety, root type, etc. There may be many reasons for these differences and the main problem is to select the cases where the noted phenomenon is caused by soil conditions and not by management. To do so, attention must be paid in the first place to the spots with the highest yields. If the yields are much above the average of the whole district, then it can be assumed that both soil conditions and crop management are above standard. This means that the soil conditions in question represent the local optimum and thus forms the starting point of an effective classification of the soils in the district concerned.

For details or semi-detail classification research is absolutely necessary to locate the exact reason that hampers the quantity as well as quality. To do this it is rather better to classify by taking quantity and quality into consideration. I call this way of classification as Q^2 system. The work should be carried out in a year wise plot which will benefit important data in a shorter time. Further, the factors that are inter-related with the orchard also can be classified as factorial n_1, n_2, n_3 and so on. These factorial number will explain by itself the cause of difference of orchard within the same soil type. Now if I say $Q^2/n_1 + n_2$, that means in this F_{n_1} and n_2 are the prima facie factors connected with the orchard shunted the value of Q^2 .

115. An investigation into the suitability of some river clay soils for apple in Jonathan variety.

K. C. BHATTACHARYYA, Calcutta.

The investigation work was carried out in Holland to see the relationship of soil and apple tree of the variety but with different root types.

The detail soil profile of this row can be seen from graph No. 8. Soil types are as follows according to the serial number of the trees :—

<i>No. of trees.</i>	<i>Soil types.</i>
1 to 23 trees	RS6
24 to 33 „	RS3+ +
34 to 52 „	RS3--
53 to 62 „	RSK

It will appear from graph No. 9 that the circumference of stem of root type XVI at 50 c.m. is bigger than the root type IV with a very little deviation in case of tree No. 24. There is a depression of graph between tree Nos. 36 to 53 of RTIV and 37 to 51 RTXVI due to light sub-soil. In general the mean crown diameter is bigger in case of RTXVI. It is apparent from the graph Nos. 9 and 12 that there is some co-relation between the circumference of stem at tree Nos. 36 to 53 and with mean crown diameter of trees at 36 to 53. There is also a co-relation between the height of trees at 36 to 62 of RTXVI (graph No. 11) and mean crown diameter of RTXVI of the trees at 36 to 62 (Graph No. 12). It will appear from graph No. 10 that the volume is more in most of the cases of the RTXVI than that of RTIV. It is apparent from graph No. 13 for the investigation of root system that the maximum root depth is up to 76 c.m. in case of tree No. 47 and No. 48. The roots are maximum within 30 to 50 c.m. and 0-20 c.m. There are only two roots which we find between 70 to 76 c.m.

116. An investigation into the suitability of some river clay soils for golden delicious and Cox orange peppin varieties of apple.

K. C. BHATTACHARYYA, Calcutta.

The investigation was carried out in an Orchard in the Vicinity of Ingen, Holland in October, 1958, to see the soil and horticultural crops relationships with special reference to some varieties of apple like Golden delicious (type IV), Cox's orange peppin (type IV). The apple trees were only eight years old.

In case of this row there are four soil types which can be seen from graph No. 1 of the detail soil profile. Here a remarkable differences between the same varieties and root type have been observed. It will appear from graph No. 7 that the roots don't go in coarse sand. There is no much difference in circumference of stem at 50 c.m. from the surface soil in both the varieties. In case of the circumference of stem we find that there is a depression of the graph between tree Nos. 32 to 48 of Golden delicious variety and the same depression can also be observed in case of the height of the tree between 38 to 48. The more or less the same pattern of curve can be seen in case of the circumference of stem, height of the tree, mean crown diameter and diameter of crown. This may be due to very light sub-soil. The circumference of stem in case of Cox variety is more than the Golden delicious variety.

It is clear from graph No. 6 that the attack of Nectria is much more in case of Cox variety compared to Golden delicious variety. Not a single tree of Cox variety was free of Nectria but quite a number of Golden delicious variety was free of Nectria.

SECTION OF PHYSIOLOGY

President :—DR. A. ROY, M.Sc., P.R.S., Ph.D. (Lond.).

Abstracts.

BLOOD

1. Studies on seasonal variation in certain haematological attributes in sheep.

B. P. SEN GUPTA, Mathura.

Effect of season on certain haematological attributes in sheep with particular emphasis on the eosinophil level was studied. Total W.B.C./cu.mm. during the three seasons under investigation—rain, winter and summer—showed no significant differences. The figures are: rain, 12805 ± 672.1 ; winter, 12718 ± 528.4 , summer, 11428 ± 568.6 . Eosinophil level during both summer ($14.2 \pm 2.5\%$) and rain ($12.6 \pm 1.1\%$) were much higher than that during the winter ($5.9 \pm 0.4\%$) and the difference between rain and winter and summer and winter were highly significant ($t_{\frac{r}{w}} = 5.7$; $t_{\frac{s}{w}} = 4.9$). The other leucocytes did not show any significant variation during the different seasons.

The correlation between eosinophil and neutrophil or lymphocyte level of blood during summer, rain and winter were negative but insignificant except in one case where the correlation between eosinophil and neutrophil during summer was negative but significant ($t = -4.6$).

The frequency distribution of the various levels of eosinophil was also different during different seasons. During both rain and summer frequency of the "upto 5%" group was nil whereas during winter the same group constituted about 40% of the total. Frequency of "10% and above" group was nil in winter but the rain and summer was respectively 68% and 65%.

Concurrently with the above studies, estimations of haemoglobin content, haematocrit value and sedimentation rate were also made. The respective values are as follows:— 9.1 ± 0.2 gm/100 c.c. of blood; 28.5 ± 0.8 per cent volume; 4.5 ± 0.2 mm/7 hrs.

No specific cause could be attributed to the seasonal fluctuation in eosinophil level of blood. Possible influence of parasitism during both rain and summer could not also be confirmed because counts made prior to and following anthelmintic treatment in these animals showed no significant difference. The low eosinophil level of blood during winter may presumably be due to an internal physiological stressful condition viz. gestation and parturition in these animals which incidentally coincided with this part of the year.

2. Physiological factors affecting the composition of chicken blood and tissues.

A. K. PAUL, R. CHANDA and B. C. CHAKRABORTY, Calcutta.

A series of experiments were carried out to find the effect of certain physiological factors, e.g. (1) breed difference between Rhode Island Red (R.I.R.) and White Leghorn (W.L.), (2) treatment with thyroxine, and (3) vitamin A deficiency on the composition of chicken blood and tissues with special reference to phosphatase, phosphorus compounds, and tocopherol. The results can best be summarised as follows:

Difference between breeds. The most striking difference was that blood and liver phosphatase concentrations were greater in W.L. chickens than in R.I.R. chickens throughout an experimental period of 16 weeks beginning from day-old chicks. The inorganic P content of blood serum was found to be positively correlated with phosphatase; in chicks of comparable age more inorganic P was present in W.L. than in R.I.R. blood serum. Both the inorganic P and phosphatase were also found to be greater in W.L. than in R.I.R. intestines. Somewhat larger concentration of protein was observed in the liver of W.L. than R.I.R. chicks upto the age of 8 weeks, but as the liver weight of W.L. chick was less than R.I.R. chick, the total amount of protein stored in the liver was much the same in the two breeds.

No breed difference was found in respect to serum lipid content, but the tocopherol content in the blood serum of W.L. birds was greater than in R.I.R. birds of comparable age; the reverse was found in case of liver tocopherol. The liver cholesterol content was also found to be somewhat greater in the W.L. than in R.I.R. chicks. Femur and tibia accounted for 1.3% and 0.8% of the total body weight of birds in both breeds. No significant breed difference was noticed in these figures or in the detailed composition of bone in respect to bone ash, Ca/P ratio and phosphatase.

Effect of thyroxine. The average daily increased in R.I.R. chicks was found to be greater than in W.L. chicks during an 8-week experimental period. In both the breeds, thyroxine treatment accelerated the rate of growth and this was made at higher efficiency of food utilisation.

Both the inorganic P and ester P were fairly high in the blood serum of day-old chicks. These values were correlated with high phosphatase content of the serum. During subsequent 8-week period, the inorganic and ester P decreased with age, but the decrease was more marked in the hormone treated groups. Phosphatase content of blood serum also decreased with age, showed a second maxima at 4-week, but decreased again between the 4th and the 8th week. There was no difference between the control and hormone treated groups in respect to the second maxima of phosphatase at 4-week, but the rate of decrease between the 4th and the 8th week was less in the hormone treated birds. The positive correlation between phosphatase and inorganic P in blood serum persisted during the hormone treatment.

The tocopherol content in both the blood serum and the liver increased with age, but the rate of increase in serum tocopherol content was greater in the hormone treated than in control birds; the reverse trend was noticeable in respect to liver tocopherol.

Vitamin A deficiency. Vitamin A deficiency in chicks developed between the 4th and the 6th week when day-old chicks were subjected to a vitamin A-free diet. The most notable biochemical changes were the smaller content of phosphatase in the blood serum and liver, and in the liver cholesterol content in treated groups. In the blood serum the decrease in the phosphatase was associated with a simultaneous decrease in the inorganic P. The weights of femur and tibia and the bone ash content were also found to be lower in the vitamin A deficiency groups than in the control vitamin A supplemented group.

3. Comparative morphological and biochemical constituents in blood of cattle and goat under farm and field conditions in West Bengal.

J. SENGUPTA, N. C. DEB and R. CHANDA, Calcutta.

A detailed investigation was carried out on the morphological and biochemical constituents in the blood of various classes of stock (cattle, buffalo, goat) under field conditions in West Bengal. The objective was to evaluate the existence and

incidence of nutritional deficiency diseases. The field samples of blood were mainly obtained from slaughter houses in the State. In order to correctly assess the findings, blood of normal cows (cattle and buffalo) and of goats (male and female) were also obtained periodically from animals of the State Livestock Research Station in Haringhata. The investigation was carried throughout one year, which was broadly divided into three main seasons, e.g., summer (March to June), Monsoon (July to October) and winter (November to February).

The results showed that the haemoglobin levels in g./100 ml. and their standard errors in normal male and female goats of the Black Bengal Breed were 11.4 ± 0.21 (83) and 9.8 ± 0.18 (73) respectively as compared to 9.0 ± 0.52 (40) and 7.7 ± 0.32 (18) respectively in field male and female goats. As compared with the normal goats of the Haringhata Farm, different types of anaemia were found to be present in field goats; the assessment was made from detailed blood picture, e.g., R.B.C., W.B.C., haematocrit, haemoglobin, M.C.H.C., etc. Hypochromic anaemia demonstrated in male goats was presumably due to Fe and Cu deficiency, or to worm infestation (haemorrhagic anaemia). Aplastic anaemia was noticed in both the female and castrated goats although it was less pronounced in the latter. Leucopenia was demonstrated in all field goats.

The content of haemoglobin was smaller in the field than in the farm cows and she-buffaloes. The biochemical constituents, except sugar, of field animals were also lower in the field than in the farm animals; the deficiency in the field animals was more marked in respect to the contents of inorganic P, total P and phosphatase of the blood serum.

4. Thermal reactions in Buffalo bulls.

G. V. RAGHAVAN and D. N. MULLICK, Izatnagar.

Data are presented on the influence of increasing air temperature and humidity from 65°F to 92°F and 33% to 75% respectively and monthly on red and white blood cells, haemoglobin level, cell volume and sugar in whole blood and inorganic phosphorus, calcium and magnesium in serum and weekly pulse rate, respiration rate, body temperature of 8 normal adult buffalo bulls.

The physiological reactions showed a positive correlation with the increase in air temperature whereas except pulse rate the other two constituents were depressed due to increase in relative humidity when the latter value was nearer to 75% though the air temperature was much less.

The white blood cells, haemoglobin and cell volume recorded a decline with the increase in air temperature whereas the calcium showed an opposite trend. Though there were variations in the serum inorganic phosphorus and magnesium due to increase in the air temperature, the trend was irregular.

5. Effect of different doses of work on concentration of protein, cell volume and haemoglobin of blood.

S. R. MAITRA, Calcutta.

In two subjects of which in one 720 kgm of work requiring 1.7 to 1.8 litres O_2 per minute, 1028 kgm requiring 2.33 to 2.47 litres of O_2 per minute, 14.39 kgm requiring 3.29 to 3.6 litres of O_2 per minute and in the other 617 kgm requiring 1.55 to 1.60 litres O_2 ; 926 kgm requiring 1.96 to 1.98 litres O_2 and 1234 kgm requiring 2.98 to 3.2 litres of O_2 per minute were given with the help of bicycle ergometer. The changes were noted in concentration of protein, cell volume and haemoglobin of blood in all doses of work. The increased dose of work produced

increased changes in concentration of protein, cell volume and haemoglobin. Taking 100% O₂ as inspired air it was shown that these changes are not due to lactic acid. Moreover, the maximum changes produced by working to the fatigue point revert back to normal level by half an hour's rest after the work. Whether these changes are occurring due to diffusion mechanism is discussed. It is suggested that besides diffusion some other mechanism must play some part as it is difficult to explain diffusion, due to permeability changes, can occur so rapidly.

6. Serum lipoproteins and glycoproteins in aminopterin treated rats.

KRISHNASUDHA ROHATGI and SACHCHIDANANDA BANERJEE, Bikaner.

Different fractions of serum lipoproteins and glycoproteins were determined by paper electrophoresis in aminopterin induced folic acid deficient and paired fed normal rats. Total lipid, esterified cholesterol, total cholesterol and neutral fat were also estimated in the serum of these animals. In the aminopterin treated animals there were significant increase in the beta lipoprotein and O fraction, no change in the alpha lipoprotein and increase in total lipid, neutral fat and total and esterified cholesterol. There was no significant change in the total glycoprotein of the serum. The results indicate that lipid metabolism is greatly disturbed in aminopterin induced folic acid deficient rats.

7. Studies of haemoglobin in aminopterin-induced folic acid deficient rats by paper electrophoresis.

KRISHNASUDHA ROHATGI and SACHCHIDANANDA BANERJEE, Calcutta.

In folic acid deficiency in rats, an increased porphyrin secretion with decrease in haemoglobin content has usually been observed. In order to study whether folic acid deficiency in rat would affect the electrophoretic mobility of haemoglobin, paper electrophoresis of haemoglobin of deficient and pair-fed normal rats were carried out. For obtaining comparatively values, electrophoresis of normal human haemoglobin as well as human and rat serum were also run. The electrophoretic mobility of normal rat haemoglobin was found to be same as normal human haemoglobin and this did not change when the rats were deficient in folic acid. The position of all haemoglobin bands were found to be at the B position of the proteinogram of normal rat and human serum. These observations indicate that there is no change in the composition of the globin part of the haemoglobin molecule in folic acid deficiency and confirms that the nature of haemoglobin is not affected by the nutritional deficiency, as has been observed in different hereditary haemoglobinopathies

8. A study on Plasma-iron Clearance with Low Doses of Fe⁵⁹Cl₃.

FAZLE HOSAIN and PARVATHI HOSAIN, Calcutta.

A number of normal subjects and patients have been studied for plasma-iron clearance using reduced doses of Fe⁵⁹Cl₃, about 0.04 μ c/kg of body weight. Half-clearance time of plasma-iron has been obtained by graphical method. It has also been calculated out from the 5 and 45 minutes plasma activity; clearance constant and clearance rate have also been calculated. The radioactive assay of 0.2 ml. plasma samples has been made with an anticoincidence gas-flow counter. The half-clearance time of plasma-iron for children were found to be comparatively shorter than those of normal adults, and in case of pregnancy these values

were found to be more shortened. Few iron deficiency anaemia and cancerous cases have also been studied. A value 85 ± 25 minutes can be taken as the normal value of the half-clearance time.

9. Blood Prothrombin level in Hypervitaminosis A.

NANDA RANI RAY, AMAL RAY and D. P. SADHU, Calcutta.

Haemorrhagic symptoms in hypervitaminosis A led to the study of the prothrombin time of blood. The blood was collected directly from the heart of albino rat after ten days of the administration of 30,000 I.U. of vit. A per day per rat and the prothrombin time was determined by the methods described by Quick and dilution methods by Campbell et al. It was found that the prothrombin time does not show any remarkable change by Quick's method which shows 24 ± 3.5 seconds both in treated and control group of rat. The dilution method showed a remarkable change in the treated group which is 61 ± 8.5 seconds in comparison to control group which is 30 ± 1.05 seconds. Thus hypervitaminosis A causes a marked hypoprothrombinemia in rat and this might be one of the causes of haemorrhagic symptoms due to excess vitamin A intake.

CIRCULATION

10. Investigation of the Stoppage of the Heart Sounds and Pulse by Yogis.

B. K. ANAND and G. S. CHHINA, New Delhi.

The paper deals with the studies on yogis who claim to stop the heart and pulse. Findings in four yogis practising this feat are being presented here.

Simultaneous records of electroencephalograph, electrocardiograph, respiration, finger volume and blood pressure were taken in the subjects investigated. The activity of the heart was observed under the X-rays and sounds heard with stethoscope and recorded on a tape recorder. The subjects mostly stopped their breath in inspiration or expiration and then tried to increase the intrathoracic pressure. Disappearance of heart sounds and radial pulse, engorgement of the neck veins and quickening of heart rate recorded by electrocardiograph, was observed when sounds disappeared. Skiagram of the chest showed narrowing of the heart in transverse diameter. Slowing of heart rate and rise of blood pressure was recorded immediately after the appearance of heart sounds. The alpha activity of brain disappeared during the attempt to stop the heart. All these findings seem to be due to a diminished venous return brought about by increased intrathoracic pressure and hence diminished cardiac output resulting in the absence of pulse. Some yogis produce reflex slowing of the heart by attempting to increase the blood pressure by various means.

11. A relationship between the body temperature and the Cardiac rhythm.

SUKHEN CHAUDHURI and D. P. SADHU (Calcutta).

Albino Rabbits (body wt. 300 gm. to 350 gm.) and adult pigeons were used for the experiment. Hyperthermia was induced by increasing the ambient temperature and surface heating. The experiments were performed in two groups. In group I the body temperature of the rabbits was increased by 2°C and of the pigeons by 2.5°C . In the second group the observations were carried out at an

increased body temperature of the rabbits by 3°C and of the pigeons by 3.5°C. The normal heart rates of the rabbits and pigeons were noted to be 225 to 240 per minute and 250 to 270 per minute respectively. In group I and II of the rabbits at an increased body temperature by 2°C and 3°C. The heart rates were 310 to 325 per min. and 360 to 390 per min. respectively and in group I and group II of the pigeons at an increased body temperature by 2.5°C and 3.5°C the heart rates were 340 to 355 per min. and 370 to 415 per min. respectively. The results show that tachycardia is induced in hyperthermia and there is a definite thermocardiac relationship and the Cardiac rhythm varies directly with the body temperature.

RESPIRATION

12. Influence of rate of breathing on Maximum Breathing Capacity.

H. D. SINGH, Madurai.

In order to determine the effect of rate of breathing on maximum breathing capacity (MBC), records of MBC were obtained with a Collin's 9-Litre Respirometer on 15 healthy adult male subjects. Each subject performed the test at graded rates of breathing ranging from 10-210 respirations per minute (r.p.m.). It was observed that MBC values which were only about 24% of the highest mean at 10 r.p.m., increased rapidly up to 50 r.p.m. and then more gradually, reaching a peak between 120 and 160 r.p.m. beyond which the values fell. The volume of air breathed per respiration was about 89-90% of Vital capacity (VC) at breathing rates of 10 r.p.m., decreased rapidly till 80 r.p.m. after which it continued to fall more gradually with increasing rates; at rates yielding highest MBC the volume was about 20-30% of VC, and at 210 r.p.m. it fell to 12-15% of VC. In addition to the maintenance of depth of breathing, an optimum rate is an important factor in the performance of this test.

13. Pulmonary Function Studies : Variations with Body postures.

H. D. SINGH, Madurai.

Variations in Vital capacity (VC), Maximum Breathing capacity (MBC), and Maximum Expiratory Pressure (MEP) with posture were studied in 15 healthy adult male subjects. VC and MBC were recorded with a Collin's 9-Litre Respirometer and the values corrected for BTPS; MEP was determined with a mercury manometer. Determinations were made with the subjects in the three postures in the following order.

(i) Standing, (ii) Sitting, (iii) Lying supine, Mean values in the respective positions were.

VC. in c.c.s	... (i) 4063	(ii) 4073	(iii) 3887
MBC. Litres/min.	... (i) 167.9	(ii) 164.8	(iii) 150.5
MEP. mm. Hg.	... (i) 100	(ii) 98	(iii) 85.8

The significance of the differences was examined statistically. The variations between the standing and sitting postures are not significant, but the reduction in the supine position is appreciable. In view of the significant lowering of values in the supine position, the body posture in which a determination was made should be known for the proper assessment of any reported value.

14. Arterial Carbon Dioxide in Heat Polypnoea in Dogs.

S KUMAR and A. S. SINHA, Patna.

It has been previously observed that on raising the temperature to about 42°C dogs pant and their respiration rate reaches as high as 300 per minute or more. In men forced breathing of such a high order is incompatible with life. The nature of heat polypnoea was therefore sought to be investigated under chloralose anaesthesia. With the onset of heat polypnoea the arterial carbon dioxide content fell from an average normal content of 41% to as low as 14.5%. This was not associated with any untoward symptoms in dogs. It is suggested that temperature compensates for the loss of carbon dioxide and thus maintains the activity of the respiratory centre, and that temperature regulation takes precedence over conservation of carbon dioxide.

DIGESTION**15. Influence of gastric impulses on the electrical activity of hypothalamic feeding centres.**

K. N. SHARMA, B. K. ANAND, BALDEV SINGH and S. DUA, New Delhi.

It is well recognised now that there exists a dual mechanism in the hypothalamus for the regulation of "feeding behaviour". The present study pertains to the possible role of sensations from gastro-intestinal tract in influencing the activity of these regions of the brain.

Bipolar electrodes were implanted stereotaxically in the hypothalamic and other cortical regions of the animals (cats and monkeys). A balloon attached to a rubber catheter (which had a side pressure bulb to increase or decrease the pressure in the balloon) was introduced into the stomach through the mouth. The electrical activity of these regions of the brain and the pressure changes in the stomach were recorded with an electroencephalograph with an attached transducer and Balance-Demodulator in one of its channels. Ballooning of the stomach evoked potentials in the satiety regions of the hypothalamus which correlated well with increasing intragastric pressures. No significant change was observed from feeding and other hypothalamic regions as well as cortical regions of the brain.

These results indicate an increased activity of the satiety centre with the increase in intragastric pressure—a state which can be simulated to the fed state. This lends support to the importance of the role of gastric afferents in the regulation of food intake.

Further studies are being conducted to map out the gastric afferents in detail and see the influence of amount of food as well as its physical and chemical nature of the activity of these centres.

16. Results of the study of the effect of various food preparations on the gastric secretory function as determined by standard intubation method and the tubeless method.

M. L. PAI and B. K. APTE, Baroda.

The examination of gastric secretory function is routinely carried out by the method of fractional gastric analysis. This method however, has some disadvantages. The subject does not like being troubled by the introduction of the

stomach tube. Secondly the presence of the tube tends to alter the composition of the juice. A tubeless method therefore will have no such disadvantages. Use of a cation exchange indicator has been suggested for such a test. Diagnex is a product obtained by replacing the hydrogen ions of the carboxylic acid groups with quininium ions. In presence of free hydrochloric acid, e.g. of gastric juice, its hydrogen cation will replace and release the quininium action, which is absorbed in the small intestine and approximately one-third is excreted in the urine. The test is thus based on the quantitative estimation of quinine in urine.

The subjects belonging to different types of responses, namely, achlorhydria, hypochlorhydria, isochlorhydria and hyperchlorhydria as determined by the fractional gastric analysis method after alcohol and/or histamine meal tests, are investigated and the quantitative estimation of their urinary quinine excretion after the diagnex test is done according to the method described in earlier communications (Pai, 1956 and Pai, 1957). These latter results were compared with those of fractional method. The effect of food preparations like cheese, mava etc., on the gastric secretory function as determined by the standard intubation method and the tubeless method has been studied in the normal subjects. The results of this study have been reported in the paper.

ENDOCRINOLOGY

17. Effect of 3:5:3' Triiodothyronine on onset and duration of action of testosterone propionate.

AMIYA B. KAR, Lucknow.

Concurrent administration of testosterone propionate (TP) and 3:5:3' triiodothyronine (TIT) to castrated rats did not alter the onset and duration of action of the former as shown by the changes in fructose concentration of the coagulating glands. However, the concentration of this substance in the combined treatment group was significantly low initially in comparison to the group injected with TP alone. When a single dose of TP was administered to castrated rats pre-treated with TIT, interesting *quantitative* differences were noticed in the onset and duration of action of the former as compared to the group treated with the androgen alone. However, the *pattern* of onset and duration of TP action were similar whether single TP injection followed TIT pre-treatment or without any such pre-treatment. Alteration of sensitivity of the accessory sexual organs to TP by TIT was implicated as the cause of these observed changes.

18. Some observations on the protective action of Vitamin B₁₂ against thyrotoxicosis.

V. SREENIVASAMURTHY, K. KRISHNAMURTHY, M. SWAMINATHAN
and V. SUBRAHMANYAN, Mysore.

Studies were carried out to find out the effect of vitamin B₁₂ on nitrogen retention and composition of body and liver of vitamin B₁₂ deficient rat injected with thyroxine. The results showed that in B₁₂ supplemented rats, the nitrogen retention was much higher than in the deficient ones. Data on body composition showed that vitamin B₁₂ supplemented animals had higher levels of body proteins and lower levels of fat, while the deficient animals had higher levels of fat and lower levels of body protein. There was no difference in the moisture, protein and fat contents of the livers of the two groups of animals although liver vitamin B₁₂ content was higher in the supplemented group.

19. Adrenal weight increasing factor and precorticotropin of ox anterior pituitary gland.

P. R. DAS GUPTA, Lucknow.

The adrenal weight increasing activity of a crude sterile alkaline extract of ox anterior pituitary gland and of a supernatant obtained by centrifuging a homogenate of fresh ox anterior pituitary tissue in 0.9% sodium chloride solution in both of which preparations the precorticotropin is present, was studied. That the presence of precorticotropin is responsible, at least in part, for the adrenal weight increasing activity of alkaline pituitary extract is probable but not certain.

REPRODUCTION**20. Presentation of Buffalo Semen—Metabolic behaviour of Buffalo Spermatozoa in different dilutents. I.**

P. N. SHIVASTAVA and M. M. RAZA NASIR, Izatnagar.

Previous studies in this laboratory have shown that the modified Kauschmidt's dilutor containing glucose-soda bicarb-sulphamezathine-egg-yolk is superior to other dilutors studied in extending the life of buffalo sperm preserved *in vitro*. This dilutor is now being extensively used in most of the cattle breeding farms in the country and the results in regard to the fertility rate obtainable by the use of this media have been encouraging. With a view to find out the factor or factors responsible for its superiority over other dilutors such as egg-yolk citrate and egg-yolk glycine, metabolic behaviour of buffalo sperm in the media was studied. The results indicated that anaerobic metabolism, measured in terms of fructolysis index, was lower in the modified Kauschmidt's dilutor as compared to the other two. Similarly, aerobic metabolism, measured in terms of O_2 consumption, was also lower in this dilutor as compared to the other two. It appears that sulphamezathine, besides acting as a bactericidal agent, also suppressed metabolism of spermatozoa, ensuring thereby a longer lease of life.

21. Metabolic behaviour of the spermatozoa obtained from bulls in different seasons.

A. ROY, R. C. SINHA and B. P. SEN GUPTA, Mathura.

The oxygen uptake and rate of fructolysis of spermatozoa obtained from Haryana and Murrah bulls during winter, spring and summer was studied with a view to find out, if seasons affect the semen quality in these two species differently. Based on seminal attributes like sperm density and relative number of live and dead spermatozoa, it was concluded that buffalo semen quality is more adversely affected by climatic stresses. The present study confirms the conclusion arrived at by comparing seminal attributes examined microscopically. Oxygen uptake by buffalo spermatozoa is markedly reduced during summer, while with Haryana bull spermatozoa, the variations were not significant. The rate of fructolysis follows a similar pattern.

The oxygen uptake by spermatozoa of both the species is very adversely affected when suspended in phosphate buffer, compared to those suspended in normal saline or Krebs's bicarbonate buffer. The effect of different seasons, however, studied with any of these media reveals the same pattern.

22. Respirometric study of goat semen with special reference to egg-yolk coagulating enzyme.

A. ROY, B. P. SEN GUPTA and R. C. SINHA, Mathura.

The presence of an egg-yolk coagulating enzyme present in goat seminal plasma acts as a limiting factor for the preservation of spermatozoa in vitro. The enzyme causes denaturation of the egg-yolk proteins invariably present in semen dilutors. It was found that calcium ions act as a cofactor; its removal by the addition of citrate helped prolonged sperm livability. The present study was undertaken to ascertain its effect on the oxygen uptake by spermatozoa in a Wargburg respirometer. Oxygen uptake by spermatozoa freed of the enzyme, or suppression of the enzymic activity by the addition of citrate, was more than unwashed sperm. When the enzyme was added in measured amounts to washed spermatozoa suspended in media containing egg-yolk, the oxygen uptake was reduced in proportion to the amount of the enzyme added. Oxygen uptake of spermatozoa suspended in saline phosphate buffer only was not affected by the enzyme. It appears, that the reduction in oxygen uptake is due to the immobility of the spermatozoa brought about by coagulation of the egg-yolk.

23. Chemical composition of semen and its preservation in dilutors composed of amino acids.

A. ROY, M. D. PANDE and J. S. RAWAT, Mathura.

As compared to bull spermatozoa viability of buffalo spermatozoa in usual semen dilutors has been shown to be poor. This difference could be due to many factors, of which the chemical composition of the semen obtained from the two species may be one. The concentration of certain seminal constituents (1) is reported herein, together with the seminal phosphatase activity (2), and preservation of sperm viability (3) in media made by the addition of an equal volume of aqueous solution of certain amino acids to egg-yolk. The results are :—

(1) Ca, Cl, Total P, Acid soluble P and Inorganic P in mg/100 ml. of buffalo and Haryana bull semen are : 40 ± 2.1 (25 ± 3.2); 373 ± 55.3 (247 ± 26.0); 103 ± 8.9 (47 ± 2.5); 72 ± 3.9 (29 ± 3.2); and 5.9 ± 0.5 (6.1 ± 0.5) respectively. The values in parenthesis are for bull semen.

By chromatographic analysis it has been found that the free amino acids present in semen of both the species are same; they are glycine, aspartic acid, glutamic acid, serine and alanine. By similar analytical technique it was shown that the sugar present in buffalo semen, like that in bull, is wholly accounted for as fructose.

(2) Acid and alkaline phosphatase activity in buffalo and Haryana bull semen is 308 ± 43.8 (145 ± 11.4) and 251.7 ± 37.2 (133.8 ± 14.1) Bodansky unit, respectively. The value in parenthesis are for bull semen.

(3) Full life of bull spermatozoa in glycine, l-alanine and dl-serine is : 15.4, 13.0 and 16.0 days respectively. L-glutamic acid and l-arginine, when mixed in different proportions were detrimental to spermatozoal viability.

24. Telescoping the breeding season of goats and fertility of preserved goat spermatozoa.

A. ROY and B. P. SEN GUPTA, Mathura.

Although goats are bred throughout the year, percentage of does coming in heat immediately after the advent of rain is more and this part of the year

could be considered as the "breeding season" of this species. An attempt was made to bring all the does in heat simultaneously by changing certain aspects of the management practices. This consisted in isolating the bucks during the beginning of autumn and the kids after weaning (in March); the does were maintained on a liberal ration from the beginning of June and a vasectomised buck was introduced in the herd by the end of this month. About 10 days after the introduction of the buck, the animals started coming in heat and within the next three weeks 90% of the herd were in heat with oestrus practically concentrated to four single days only.

The percentage of conception based on first service and 45 days "non-return" was found to be above 70%. The semen used was diluted ($\times 10$) in glycine egg-yolk medium and 4-24 hours old.

NUTRITION

25. Infant food from buffalo milk. VIII. Infant feeding trials with roller dried food.

M. R. CHANDRASEKHARA, T. R. DORAISWAMY, M. NARAYANA RAO,
A. N. SANKARAN, M. SWAMINATHAN and V. SUBRAHMANYAN,
Mysore.

Feeding experiments with a roller dried infant food prepared from buffalo milk were conducted under strict medical supervision on 17 infants. The infant food contained 22 per cent protein and 14 per cent fat and was fortified with vitamins A and D and all B-complex vitamins. Records regarding the growth and general health of the infants and the digestibility of food were maintained. All the infants digested the infant food readily. The infants consumed the reconstituted milk with relish and no case of vomiting after the ingestion of milk were reported. The average rate of growth of the infants was quite satisfactory and was almost similar to that obtained earlier on infants fed on spray dried infant food.

26. Effect of Pulse Protein Diets on the levels of liver and plasma cholinesterase of rats.

G. C. ESH, Calcutta.

A significant reduction in the level of liver xanthine oxidase of man and animals under protein malnutrition is well established and the regeneration of the enzyme level as a result of feeding pulse diets has already been reported from this laboratory. In view of the marked lowering of the level of liver cholinesterase in cases of both under-nutrition and malnutrition as well as in cases of some liver damages it was considered interesting to study the influence of pulse protein diets on the promotion of cholinesterase activity in the liver and plasma of rats fed at different state of growth and maintenance as well as on the regeneration of the enzyme level in protein-depleted animals. Significant increase in the enzyme level of both liver and plasma was observed when various pulses were fed to protein-depleted rats as the exclusive source of protein although there seems to be considerable variation in this capacity between pulse to pulse. Supplementation of the pulses with deficient amino acids tends to increase the enzyme activity in some cases. The data also indicate considerable variation in the enzyme level due to sex difference. The possible relationship between the enzyme levels and dietary proteins has been discussed.

27. Studies on Edible Oils, Part I—Nutritive Value of Heat Treated Oils.

G. C. IISH, M. L. SEN GUPTA and S. BHATTACHARYA, Calcutta.

Authentic samples of crude arachis oil, purified arachis oil, dalda (hydrogenated vegetable oil), mustard oil, sesame oil and cocogem (treated coconut oil—Tata Oil Mills Ltd.) were heated in iron pan to 180°C for different periods of time upto 10 hours in open air and their nutritive value compared with that of untreated oils. In all cases iodine value of the heated oils declined but acid value remained almost constant. Peroxide value of the oils with initially low value increased whereas that with initially high value declined as a result of heat treatment. When fed to weanling rats at 10% level in the synthetic diet for 28 days, one-hour heated oils had no markedly adverse affect on the growth rate whereas 10-hour heated oils significantly depressed the growth rate in all cases. Cocogem, however, tended to show least adverse effect. Liver and kidney data did not demonstrate any change in the body weight—organ ratio. The relative association of lower iodine value, change in peroxide value, degree of heat treatment and level of heat treated oils in the diet with thermal deterioration of the oils has been discussed.

28. Preliminary observations on the toxicity of Cashew nut Shell Oil and its different derivatives on rats.

M. L. CHATTERJEE, Calcutta.

Cashew nut shell extract and its different products are being effectively used against helminthic infection in human cases and has given a broad range of action against different worms. Preliminary results of chronic toxicity test on oral administration of Cashew nut shell oil and its different derivatives on rats viz., Shell oil, Cardol cardanol, Anacardic Acid, and Sodium anacardate are as follows (1) After 1 gm/kg for 3 successive days—diarrhoea and loss of weight and inflammatory changes in the stomach with adhesion to surrounding organs on post mortem examination. (2) After 1 gm/kg on every 4th day for 3 successive days—there was no sign of any acute systemic toxicity. On post mortem examination, the stomach showed thickening of the wall and puckering of the fundal mucous membrane, in all the treated animals. In the rats fed on shell oil, there was in addition adhesion to surrounding organs like liver, spleen, omentum etc. Liver fat estimation showed no significant change. Histologically, proliferation of the stratified epithelium of the fundus with marked hyperkeratosis was noted which was most prominent in the animals receiving sodium anacardate.

29. A study on the comparative digestibility of the nutrients in bulls and buffalo bulls under different climatic conditions.

G. V. RAGHAVAN, BIMLA KAKKAR, M. V. N. RAO and D. N. MULLICK,
Izatnagar.

The digestibility trials were conducted on 8 Murrah buffalo bulls and 4 Haryana bulls at two ranges of air temperature and humidity. The body weight of the animals were approximately 875 lbs. and they were on maintenance ration consisting of wheat bhoosa and ground nut oil cake. Quantitative figures for water intake were also maintained during the trial period. Air temperature and relative humidity were also recorded.

The results showed that both the species reduced the digestibility of protein and fat feeds in summer months whereas carbohydrate showed an opposite trend. Between the species the percentage decrease and increase in the nutrients were

more in buffalo bulls due to rise in air temperature. As expected the water intake in summer condition was higher in both the species.

Between the species at each range of temperature the buffalo bulls consumed less feeds when they were calculated for 1000 lbs. weight the differences in the mean values of the consumption of the nutrients between the two species were higher in summer months than in winter. From these observations it seems that these two species have different heat regulating mechanisms with the help of metabolism of nutrients at higher air temperature.

30. Estimation of gross energy or heat of combustion of some common cattle feeds by bomb calorimeter.

BIMLA KAKKAR and D. N. MULLICK, Izalnagar.

25 samples of cattle feeds which are commonly used in this part of the country were analysed for the estimation of their heat of combustion or caloric value in an Adiabatic oxygen bomb calorimeter. Oil cakes which are being used as sources of proteins and fats showed highest values whereas the rice straw showed the lowest. The nutritive value of these feeds according to the conventional digestibility trials supported these observations. Some of the analytical figures showed lower values when compared with those of western workers.

31. The effect of supplementary processed protein foods fortified with essential Vitamins and Minerals on the growth and nutritional status of under-nourished weaned infants.

V. SUBRAHMANYAN, T. R. DORAISWAMY, R. K. BHAGAVAN, M. NARAYANA, RAO, A. N. SANKARAN and M. SWAMINATHAN, Mysore.

A feeding experiment extending over a period of 9 months was conducted on 54 weaned infants of ages ranging from 5-20 months to assess the value of supplementing their diet with a balanced malt food and a low cost protein food (Multi-purpose food, formula C.) On the basis of their initial heights, weights, haemoglobin content of blood, red blood cell count and nutritional status, the infants were allotted into three groups so that each group contained 10 girls and 8 boys. The increase in height, weight, red cell count and haemoglobin levels of the infants receiving the malt food and low cost protein food were significantly larger than that observed in infants in the control group receiving a supplement of rice. 80 per cent of the infants in the two experimental groups improved in their nutritional status whereas none in the control group showed improvement. On the other hand three children in the control group showed deterioration in nutritional status.

32. The effect of supplementary protein food containing cocoanut meal, groundnut and bengalgram flours on the metabolism of nitrogen, calcium and phosphorus in children subsisting on a poor rice diet.

P. K. TASKER, M. NARAYANA RAO, M. SWAMINATHAN and
V. SUBRAHMANYAN, Mysore.

The metabolism of nitrogen, calcium and phosphorus was studied during 5 days in six pairs of boys aged 10-12 years, similar in age, height and weight and fed on a diet based on rice or on the same diet supplemented daily with 2 oz of protein food consisting of a blend of low fat cocoanut meal, groundnut flour

and Bengalgram flour fortified with calcium phosphate and certain vitamins. The mean daily nitrogen intakes on the rice diet and rice-protein food diet were 6.73 and 9.94 g. respectively. All the children in the two groups maintained positive nitrogen balance. The daily nitrogen retention on the rice-protein food diet (2/12 g.) was significantly higher ($P < 0.05$) than that on the rice diet. The mean daily intakes of calcium on the rice diet and rice-protein food diet were 613 and 853 mg. respectively. All the subjects in the two groups were in positive calcium balance. The daily retention of calcium in the subjects on the rice-protein food diet (355 mg) was significantly higher ($P < 0.05$) than that observed on the rice diet (255 mg.). The mean daily intakes of phosphorus on the rice diet and rice-protein food diet were 1144 and 1483 mg. respectively. All the subjects in the two groups were in positive phosphorus balance. The daily retention of phosphorus on the rice-protein food diet (538 mg.) was significantly higher than that observed on the rice diet (434 mg.).

HISTOCHEMISTRY AND HISTOLOGY

33. A new method for staining reticulin by bromine silver method.

P. B. SEN, M. MUKHERJEE and C. DEB, Calcutta.

Composition of reticulin is not known with certainty. Polysaccharide content of it have been suggested by many workers, and a number of methods of staining it in his histological sections are based on the principle of staining those polysaccharides. In the present communication, a method, more or less specific for unsaturated lipid, found to stain reticulin beautifully, has been described. This suggests the lipoidal association of reticulin. A rigorous process of exhaustive and specific lipid extraction has been carried out. It is observed by such procedures that reticulin has lost its staining capacity. It can be postulated that reticulin is composed of substances lipoidal in nature which may or may not contain any polysaccharide. The method in short is the exposure of slides containing bouins fixed frozen section to bromine vapour for one hour, followed by washing in thiosulfate solution and treatment with ammoniacal silver nitrate solution in dark and at 37°C for one and a half hours. After several hours of reduction in formalin reticulin comes out prominently to its finest detail.

34. Effect of acute dehydration on the histochemical changes in the tissues of toad.

C. DEB, M. MUKHERJEE and S. SENGUPTA, Calcutta.

Effect of acute water deprivation for 48 hours has been studied histochemically in kidney, liver, adrenals and intestine of toad.

It has been observed that deprivation of water caused reduced glomerular filtration and increased tubular reabsorption in toad. Reduced glomerular activity was responsible for fall in plasmal but rise in acid phosphatase. Increased tubular reabsorption on the other hand caused a rise in plasmal but fall in acid phosphatase. There was also a rise in succinic dehydrogenase and esterase in dehydrated kidney. In liver there was a fall in neutral fat, plasmal, acid and alkaline phosphatase in dehydrated condition. In adrenals there was a depletion of neutral fat, unsaturated lipid and plasmal due to stress produced when kept out of contact with water. In intestine a fall in P.A. Schiff positive substance indicated reduced synthesis of mucin under similar condition.

35. Species variation in the distribution of some cytoplasmic constituents in liver.

C. SARKAR, M. MUKHERJEE and C. DEB, Calcutta.

In order to find out species variation in metabolic pattern of fat and carbohydrate in liver present experiment was carried out.

Fish liver was found to contain highest amount of succinic dehydrogenase, plasmalogen and neutral lipid and no P.A. Schiff positive substance. This indicated that fish liver is designed for fat metabolism. Whereas, guineapig liver gave the opposite picture, there being no fat (Sudan demonstrable), very little plasmal, comparatively lesser amount of succinic dehydrogenase and much higher amount of glycogen, indicating its inclination towards carbohydrate metabolism. In between these two seemingly opposite nature of livers remained cockroach's hepatic cica resembling that of fish and toad's liver inclined towards guineapig. Succinic dehydrogenase was very high in cockroach-hepatic cica and minimum in toad's liver, both contain fairly a high amount of plasmal and P.A.S. positive substance, neutral fat content of hepatic cica was fairly high and that of toad liver was nil

BIOPHYSICS**36. Electrical activity of the hypothalamic feeding centers under the effect of changes in amino acid and fat content of the blood.**

B. K. ANAND, S. DUA and BALDEV SINGH, New Delhi.

In continuation of the studies carried out last year to explain the mechanism of action of the hypothalamic feeding centers, work was further extended to find out the effect of changes in protein and fat content of the blood on the electrical activity of the hypothalamic feeding centers. The activity of these regions as well as cortical regions was recorded through permanently implanted bipolar parallel electrodes on an 8 channel electroencephalographic machine both, before and after increasing the protein and fat contents of the blood on different days. A solution of protein hydrolysate (Bengal Immunity) and Lipomul (Upjohn & Co.) was used to increase the protein and fat content of blood respectively. Blood samples were estimated for total protein and lipid contents before and $\frac{1}{2}$ hour and 1 hour after injections. No appreciable change in the electrical activity was observed in feeding, satiety, other hypothalamic or cortical regions. Sudden infusion of protein hydrolysate produced a state of protein shock in few animals with a generalised inhibitors of the activity of all the regions.

37. Studies on Shri Ramanand Yogi during his stay in an air tight box.

B. K. ANAND and G. S. CHHINA, New Delhi.

The yogi was tested in a glass-cum-metal air tight box measuring 6' x 4' x 4'. Recording of electro-cardiograph, electroencephalograph, respiration and heart rate was done at regular intervals with offner 8 channel electroencephalograph machine. The yogi stayed in the box twice for 8 and 10 hours respectively. First time he lighted a candle inside the box, which went off after 3 hours. The normal basal oxygen consumption of the yogi was 19.5 litres-hour. The gas analysis of air samples withdrawn from the box showed that yogi consumed oxygen 26.9 litres/hour during the first three hours and 12.2 litres/hour on an average in the remaining period. Second time he consumed oxygen on an average rate of 13.3 litres/hour. Oxygen consumption was more than basal level during the first two

hours, less than the average values in the middle and somewhat more than average during the last 3 hours. Respiration and heart rate of yogi was not increased with 4 to 5% CO₂ concentrations.

Electroencephalographic recording showed sleep patterns interspersed with well marked alpha activity at places. Also persistent high voltage fast activity was recorded from occipital regions. Normal controls did not show similar changes.

38. Electromyographic studies on the efficient postures during screwdriving and fixing nails at various heights.

N. N. DAS and J. BHATTACHARYA, Calcutta.

Electromyographic studies on the muscles during rest and activity reveals the inner condition of muscles. The surface electrodes on the surface of the muscle are connected with small disc electrode which is connected by fine insulated wires to the electrode board which connects with recording electromyograph. The efficient postures of various types were studied. In this paper we are dealing with screw-driving with various postures and most efficient posture has been determined. Some experiments on nail-driving with different types of hammers were worked out. The diagrams and tables explain which is the efficient posture for these two particular jobs.

PHARMACOLOGY

39. Studies on synthetic antispasmodics. Part II.

A. N. BOSE and SRIPATI BOSE, Calcutta.

In continuation of a previous work on synthetic antispasmodics in this laboratory (Bose and Bose, *Proc. Ind. Sci. Cong.*, III, 191, 1952) further work has been carried on several other synthetic derivatives. The compounds tested belong to 2 classes;—(1) substituted β -aminoketones containing tertiary amino groups, and (2) α -acetamino-propiofenones containing β -diethylamino or β -piperidine substitution.

The antispasmodic action was determined on isolated guineapig ileum or jejunum having normal peristalsis, or under spasm induced by BaCl₂, histamine, or carbachol. Tests on perfused toad heart, isolated mammalian heart, and cat heart *in situ* were also performed. The effect on the cardiovascular and respiratory systems were studied on chloralosed cats.

The results show that all the compounds possess more or less antispasmodic properties, both neurotropic or musculotropic. On perfused toad heart, the compounds inhibit in varying degrees the action of carbachol and vagus stimulation. One of the compounds α -acetamino- β -piperidino-propiofenone-HCl exerts a powerful cardiac stimulation similar to adrenaline. At higher concentrations, all the compounds produce a negative inotropic and chronotropic effect on isolated or perfused heart. In low concentrations, however, two compounds (4-phenyl-4-benzylidene-1-piperidino-butan-3-one hydrochloride, and 4-phenyl-4-benzyl-1-piperidino-butan-3-one hydrochloride) show a definite cardiac stimulation. It is concluded that some of the β -aminoketones studied exhibit significant antispasmodic, anti-cholinergic and anti-histaminic properties to warrant further evaluation in the clinical fields.

40. Pharmacological studies with Arborine.

M. L. CHATTERJEE, Calcutta.

This alkaloid was isolated from the leaves of *Glycosmic pentaphylla* Correa (*Beng* : Ash-shoura, *Hind* : Banabimbu). Chemically it has a quinazolone grouping.

This was fairly non-toxic to mice, but caused a brief fall of blood pressure in chloralosed cats, which was not affected by vagotomy or after atropine and/or mepyramine, but absent in spinal cats. Intestinal movements were stimulated.

There was an increase of rate, of amplitude of beat, and of coronary flow of isolated guinea pig hearts, the last action was quite pronounced and none of these components were affected by mepyramine whereas of the similar effects on isolated heart after histamine, the increase in coronary flow was antagonised by mepyramine.

On isolated guinea pig ileum, there was no contraction, but a partial antagonism to the spasmogenic action of histamine and acetylcholine was seen after high doses of arborine. It caused occasional increased peristalsis and mild tonic contraction of isolated rabbit duodenum.

On isolated guinea pig seminal vesicle : arborine in high doses slightly antagonised the spasmogenic action of adrenaline and histamine. Spasmogenic action of acetylcholine and pituitrin on isolated rat uterus was completely antagonised by it. Neuromuscular blocking activity was exhibited on cat's gastrocnemius-sciatic nerve preparation.

In water loaded rats, intraperitoneal arborine in low doses (5-20 mgm/kg) increased the percentage of water excretion while high doses (80 mgm/kg) diminished it and produced methoemoglobinuria.

41. Search for newer non-mercurial oral diuretics.

J. K. MOHANTY, B. N. DAS and B. DAS, Cuttack.

The results of pharmacological and bacteriological studies of a series of heterocyclic sulphonamide compounds which are somewhat related chemically to acetazolamide as well as to chlorothiazide are presented.

Compound M63BB (Code number) seems to be the most potent of this series. As a diuretic and inhibitor of gastric secretion, it seems to be much more potent than acetazolamide which is extensively used in clinical practice. It has no antihistaminic and antiacetylcholine action. It has hardly any effect on heart, respiration and blood pressure of chloralosed dogs. Bacteriological study using *Staphylococcus aureus* as the test organism revealed its feeble antibacterial activity. The general pattern of pharmacological and antibacterial activity of other compounds of this series is qualitatively similar to that of M63BB, but quantitatively all of them are very much weaker.

42. In vitro anti-bacterial activity of a new series of sulphonamide compounds.

J. K. MOHANTY, B. N. DAS and B. DAS, Cuttack.

Eighteen compounds which are sulphonamide derivatives were studied for in vitro anti-bacterial activity. The compounds of this series could be divided into three groups depending upon their chemical configuration. In one group the free

or substituted sulphonamide group is linked to the thiazole ring at position five with the presence of an amino or aceto-amino group in position two and an aryl group in position four of the thiazole ring. The compounds of this group were found to possess only feeble anti-bacterial action.

The basic chemical structure of another group of compound was, 2-(p)-fluorophenyl sulphonamide-4 aryl-thiazole. This exhibited intermediate anti-bacterial property. The third group of compounds are really derivatives of sulphathiazole from which they differ only in having an aryl group in position four of the thiazole ring. The compounds of this group exhibited good anti-bacterial activity approximating the potency of Sodium Sulphadiazine.

43. Oral antidiabetic action of a new series of sulphonamides.

J. K. MOHANTY, B. N. DAS, B. C. KAR and B. DAS, Cuttack.

A series of sulphonamide derivatives, some of which are chemically distantly related to IPTD (p-amino-sulphonamide-isopropyl-thiadiazole) and to Sulphathiazole have been screened for possible blood sugar lowering action when given by mouth. Four of the compounds of this series exhibit some blood sugar lowering activity. However, compound M66BB (code number) is the most active of the series and compares favourably in potency with Tolbutamide, an oral antidiabetic drug used widely in clinical practice.

44. Pharmacological studies on peruvoside—a new cardiac glycoside.

J. D. KOHLI, Lucknow.

The pharmacological action of Peruvoside a new glycoside isolated from *Thevetia nerifolia* juss, by Rangaswami and Venkata Rao (J. Sc. Ind. Res. 17B, (1958) has been studied.

Peruvoside brings about systolic standstill of amphibian as well as mammalian hearts. It produces vomiting in pigeons and cats. When perfused in cats it produces E.K.G. changes typical of a cardiac glycoside. It produces positive inotropic effect in isolated hypodynamic guinea-pig heart. The intensity of action has been determined by a number of biological standardization procedures. The lethal dose in cats is 160 ± 7.5 $\mu\text{g}/\text{kg.}$, in guineapigs 709 ± 58.8 $\mu\text{g}/\text{kg.}$ and in pigeons, 263 ± 22.7 $\mu\text{g.}/\text{kg.}$ As compared to other cardiac glycosides peruvoside falls between ouabain and digoxin as regards its activity.

The absorption from the oral route was studied in cats by two methods (a) oral feeding in unanaesthetised animals (b) introduction into a particular segment of G.I. tract in anaesthetized cats. It appears that 25—40% of the drug is absorbed. It begins to be absorbed within 15 minutes and more absorption takes place from small intestines than the stomach.

Peruvoside produces a quick action, within 5 minutes after intravenous administration. The duration of action has again been studied by a number of methods (a) oral feeding and back titration at predetermined interval (b) intravenous administration and back titration at particular intervals (c) chronic cumulative toxicity by daily subcutaneous injection of 20% and 40% of the Hatcher dose. In this respect *Peruvoside* falls between ouabain and digoxin.

BIOCHEMISTRY AND METABOLISM**45. Metabolism of citric acid in scorbutic guinea pigs.**

SACHCHIDANANDA BANERJEE and H. DEVENDRA SINGH, Bikaner.

Metabolism of citric acid was studied in scorbutic guinea pigs. On feeding succinic, malic and citric acids to normal, scorbutic and insulin treated scorbutic guinea pigs. It was observed that citric acid excretion was enormously increased after the acids were fed to scorbutic animals in comparison to normal animals. Prolonged insulin injection of the deficient animals lowered the urinary excretion of citric acid considerably. After the feeding of malic acid and succinic acid, malic acid excretion was increased considerably in scorbutic guinea pigs and after the feeding of citric acid the amount of malic acid excretion was considerably small in all the groups of animals. The increased urinary excretion of citric acid after the different acids were fed seemed to be due to decreased oxidation of citric acid in scurvy. After the above acids were fed to normal guinea pigs, urinary excretion of α -ketoglutaric acid was doubled but the excretion in scorbutic guinea pigs did not increase. The aconitase activity of the different tissues of the scorbutic guinea pigs did not change from normal. Iso-citric dehydrogenase activity was found unaffected in scurvy. All these observations indicated that the site of lesion in scurvy is the defective conversion of oxalosuccinic acid to α -ketoglutaric acid by decarboxylation due to possibly to the defective action of oxalosuccinic decarboxylase. Prolonged injection of insulin to the scorbutic animals brought forth the normal metabolism of acetic acid. Hypoinsulinism associated with scurvy is possible responsible for the defective metabolism of citric acid in scorbutic guinea pigs.

46. Oxidative phosphorylation of liver mitochondria of goldfish acclimated to cold and warm temperatures.

MADHU S. KANUNGO, Cuttack.

Oxidative phosphorylation measurements made at 20°C on the mitochondria of the liver of goldfish acclimated at 10°C and 30°C showed that the P/O (micro-moles inorganic phosphate esterified/microatom oxygen consumed) and P/N (micro-mole phosphate esterified/mg. nitrogen) ratios were lower for the cold-acclimated fish. The Q (microlitre oxygen consumed/mg. N₂) for the same mitochondria were higher for the cold-acclimated fish. It has been concluded that metabolic adaptation in goldfish occurs at the cellular level by quantitative changes of several enzyme systems.

47. Glutathione, ascorbic acid and dehydroascorbic acid levels in blood of patients suffering from infectious diseases.

SACHCHIDANANDA BANERJEE and JAGADINDRANATH BHADURI, Bikaner.

The fasting blood glutathione, ascorbic acid and dehydroascorbic acid values were determined in normal subjects and in patients suffering from cholera, small pox, pyogenic meningitis, tubercular meningitis, gonorrhoea and syphilis. In all the diseased conditions studied the blood glutathione and ascorbic acid values were

diminished with a concomitant increase in the dehydroascorbic acid level. Significance of these results will be discussed.

48. Folic acid reductases in normal and in neoplastic rat liver.

B. M. BRAGANCA and U. W. KENKARE, Bombay.

Tetrahydrofolic acid is an important intermediate in the transformation of folic acid into the active vitamin, concerned with the transfer of one carbon fragments. The reduction of folic acid has been shown to occur in two steps both requiring TPNH. In studies to be reported considerable purification of the overall system concerned with reduction of folic acid in mammalian liver has been achieved. It has been possible to dissociate the apoenzyme from the cofactors and to re-activate it by the addition of flavin mononucleotide indicating the flavin nature of these enzymes.

In conformity with observations which have demonstrated that disturbance in flavin metabolism is closely associated with production of dimethyl-aminoazobenzene induced tumours; it has been possible to show that the enzymes reducing folic acid are considerably depressed in hepatomas and some other tumours as well.

The results obtained using tumour tissue will be discussed in relation to the possible mechanisms underlying the selective action of antifolic compounds on neoplastic tissue.

49. Mechanism of phosphate activation of glutaminase I in the mitochondrial systems of animal tissues.

S. R. GUHA and H. S. CHAKRAVARTI, Calcutta.

Phosphate-activated glutaminase I activity of various mitochondrial preparations of rat brain and guinea-pig liver has been studied in order to find out whether any alteration in the structural organisation of the mitochondrion produces a corresponding change in the pattern of enzyme activity. Fragmentation of mitochondrial particles by various methods resulted in marked decrease of Glutaminase I activity, although in the supernatant fluid, deamidation activity in the absence of added phosphate was considerably present. The choice of medium for the preparation of mitochondria is critical for exhibiting the activation with phosphate, since in 0.88 M sucrose solution, the activating effects of phosphate are completely counteracted while in isotonic or hypotonic medium significant activation occurs on addition of the same concentration of phosphate. In 0.88 M sucrose however a more elevated concentration of phosphate is required than that required in the system prepared in isotonic or hypotonic medium. Moreover when mitochondria prepared in hypertonic sucrose, is resuspended in isotonic medium, phosphate activation reappears. Decreased effects of phosphate addition was also observed in the presence of thyroxine and at increased pH while storage for a few days produced complete disappearance of the activating action of phosphate. All the above methods are known to cause mitochondrial swelling.

All these evidences indicate that for demonstration of phosphate activated glutaminase I, presence of intact mitochondrial anatomy is essential. Phosphate is known to cause swelling of mitochondria and if there is already any prior swelling of mitochondria, no phosphate activation of glutaminase is demonstrable. Actual demonstration of mitochondrial morphology under various conditions mentioned above is under progress and preliminary work on the change of optical density of mitochondrial preparations at $\mu 520$, corroborates our above findings.

50. Effect of glucose cycloacetoacetate (Hydrolysed) on glycogenesis and glycogenolysis in liver and diaphragm (in Vitro).

M. C. NATH and J. M. KHANADE, Nagpur.

The effect of glucose cycloacetoacetate on glycogen synthesis in liver and diaphragm and glycogenolysis in liver has been studied in vitro. Glucose cycloacetoacetate (GCA) promotes glycogen synthesis in liver and diaphragm in 36 hours fasting rats, when glycogen storage in liver and diaphragm is very low i.e. 0.6 mg./100 mg. tissue wet weight. In animals fed the normal diet, where liver glycogen values were as high as 30 mg./g. tissue wet weight. GCA caused rapid glycogenolysis rather than glycogen synthesis. During such glycogenolysis glycogen values of tissues (liver and diaphragm) reached minimum level in 90 minutes after which glycogen synthesis began in presence of GCA. In absence of GCA, however, the value of glycogen declined further.

51. The effect of glucose cycloacetoacetate on the regeneration of erythrocytes and restoration of hemoglobin level in experimental anaemia in rats.

M. G. NATH and K. G. PRASANNAN, Nagpur.

The effect of glucose cycloacetoacetate (GCA) and vitamin B₁₂ on the experimental anaemia induced by phenyl hydrazine has been studied.

GCA (hydrolysed) and vitamin B₁₂ in the dose of 10 mg. and 10 μ g/100 gm. body wt. have been found to increase the red cell count and hemoglobin levels.

The mechanism of antianaemic activity of GCA has been discussed.

52. Effect of rice polishing concentrate on liver lipids.

C. H. CHAKRABARTI, K. L. SAXENA and M. C. NATH, Nagpur.

Rice polishing concentrate is a good source of choline. The choline content of the rice polishing concentrate is 122 mg.%.

30 ml. of the concentrate when added to 0.04% choline containing basal diet can prevent the development of fatty liver.

This prevention of fatty liver by rice polishing concentrate cannot be accounted for its choline contents alone.

It has been postulated that some other lipotropic substances besides choline are present in rice polishing concentrate which are helping transmethylation reaction.

53. The effect of different food fats on experimental atherosclerosis and the beneficial effect of essential fatty acids : Vitamin B₁₂ and hydrolysed glucose cycloacetoacetate.

M. C. NATH and A. SAIKIA, Nagpur.

On feeding hydrogenated vegetable fat (Dalda) to the rabbits, the serum cholesterol, phospholipid levels and the C/P ratio were found to be much higher than those of the animals kept either on linseed oil or hydrogenated fat supplemented with linseed oil or a mixture of essential fatty acids.

Hydrogenated vegetable fat raised the tissue cholesterol and C/P ratio but lowered the F/T ratio of the animals.

The elevated serum and tissue lipid levels and C/P ratio of the animals kept on hydrogenated vegetable fat were reduced considerably when the animals were injected with GCA hydrolysed even to a greater extent than that of the animals kept on dalda and linseed oil.

The effect of essential fatty acid mixture in maintaining the normal serum and tissue lipid levels and their C/P and I/T ratios were markedly pronounced when the animals were injected either with GCA (hydrolysed) or vitamin B₁₂.

Hydrogenated vegetable fat diet was found to cause the highest percentage of liver fat with low Iodine Value in comparison to other groups. Normal level of liver fat and higher I.V. were noted in case of the animals kept on essential fatty acid mixture supplemented dalda diet and injected with hydrolysed GCA.

Maximum gain in body weight was noted in case of unsaturated fat diet and also in case of the animals kept on hydrolysed GCA along with essential fatty acid supplemented dalda diet.

It has been suggested that the unknown factor present in the unsaponifiable fraction of crude oils, responsible for lowering the serum cholesterol may be in some way or other related to GCA or its product of hydrolysis.

SECTION OF PSYCHOLOGY & EDUCATIONAL SCIENCES

*President :—*DR. D. GANGULY, M.Sc., Ph.D.

Abstracts.

I. GENERAL PSYCHOLOGY

(a) Theoretical

1. The Probable Trend of Modern Psychology in Future.

N. K. DAS GUPTA, Santiniketan, West Bengal.

Psychology, in the past, was concerned with mental activities in the ordinary waking consciousness, or in other words, it was confined into activities only of our surface mind. Hence it was one dimensional.

Early in the twentieth century with the epoch making discovery of the unconscious mind by Dr. Sigmund Freud a new branch of psychology, namely, *Depth-psychology* has come into existence. Since then dream, delusion, neurosis, psychosis have become important matters of investigation for psychology. Psychology, thus dealing with the data of the conscious mind as well as that of the sub-conscious or unconscious mind, has become now two dimensional.

The modern psychology, though considered as an infant science, has unravelled many a mystery belonging to the nether region of human mind, but far greater and still more mysterious is the dark region of mind as revealed by the past Indian Yogis and the psychologist, and particularly at present by Sri Aurobindo.

Sri Aurobindo has visualised two other dimensions besides the above (conscious and subconscious), namely, *Inconscient* and *Superconscient*, the former being in the lowest end of the consciousness while the latter in the highest. These indicate the probable expansion of modern psychology into altogether new direction.

The recent investigation and work of psychology under the name of *Para-Psychology* in the West as well as in India adequately show that the science of psychology shall have to expand its field of investigation into regions now dealt with by the Yogis and mystics in their own way.

2. Ethology—The Science of Behaviour.

H. C. GANGULI, Kharagpur.

Ethology is a term offered by Tinbergen to denote the science of causation of behaviour. Tinbergen has discussed in his text, *Study of Instinct*, the methods and problems of ethology. According to him, ethology is primarily interested in isolating the causes of instinctive behaviour in infrahuman species. In the field of external causes of behaviour ethologists have amassed a large number of data and developed new concepts or brought into prominence old ones. It is postulated that there are specific 'sign stimuli' (perceptual cues?) which by acting upon the Innate Releasing Mechanism lead to the evocation of a specific instinctive response. For example, 'red belly' is the sign stimulus for release of the fighting response in the sexually active male three-spined stickleback; 'short

neck' is the sign stimulus for escape reactions in ducks, geese etc. A tentative hypothesis of a hierarchical system of nerve centres is postulated for explaining the mechanism of instinctive behaviour.

Certain concepts like the distinction between 'appetitive' and 'consummatory' acts or of the 'sign stimulus' as distinct from the psychologist's concept of 'effective' stimulus are of great value to psychologists, especially animal psychologists. However ethology's contribution towards internal or motivational factors are distinctly less than of the psychologist. Further, the positioning of ethology between neuro-physiology and psychology and description of the latter as dealing with 'subjective' phenomenon may not be justified by the nature and existing state of research in these fields. It is probable that ethology will find it more and more difficult to maintain an independent status as both neuro-physiology and psychology continue to grow at an accelerated rate.

3. The present status of the concept of perceptual defence.

BISHWA NATH MUKHERJEE, Patna.

The 'perceptual defense' controversy has been an area of considerable interest during the recent years. A survey of the experimental studies which both support and question the 'perceptual defense' hypothesis, has been presented in this paper. It has been shown that many of the earlier studies are open to criticism both on methodological grounds and in their rationale. The most important fact overlooked earlier is that perceptual defense is not a general phenomenon but strictly an individual reaction which may be specific to given aspect of a particular area of conflict. A few recent studies designed with this orientation and exercising controls over word frequency, response readiness or set found evidence in favour of perceptual defense theory. Such personality centered studies of perceptual defense are in a position to demonstrate the possibility of predicting perceptual defense behaviour from the individual's preference for a particular defense mechanism. The present status of the concept, therefore, appears to be more or less established. But further probe both into the nature of the concept and possibility of exploring better experimental methods is very necessary to bring a resolution in the controversy. Such attempt might lead to the formulation of certain laws governing the process of perceptual defense.

4. Concepts of Normality Reviewed.

NIROD MUKERJI, Bombay.

1. Two basic concepts in use viz., statistical (including ethical) and psychological. The former is a concept of convenience portraying still picture of dynamic living. It however presumes the bipolar modes in which an incident may take place.

2. Futility of purely psychic concept, psychosomatic concept more plausible. Part played by fronto-hypothalamic mechanism and endocrinal homeostasis ; further clarity evinced in the bipolar modes of events. In the course of evolution distinction has arisen between sheer negation of an event and its opposite.

3. Search for the axes whose relationship delineates psychosomatic normality.

Conclusions.

5. Psychology in ancient India and modern research.

H. N. MURTHY, Ranchi.

Sankara accepts the science that deals with the "agent" and "actions" (San-khya) as authoritative within that realm. Analysis of behaviour and its usefulness is not rejected by him.

An examination of certain hypotheses which may thus be empirically useful within limited ranges, can be classified, from the clinical point of view into these three fields : (1) Experimental Studies (Types according to morphology and temperament ; studies in perception, learning etc.). (2) Analytical studies in the realm of mythology and cultural roots. (3) The Foundations of Psychotherapy.

It is felt that the various hypotheses of Ancient Indian Psychology can be fitted into modern experimental design and verified.

(b) Experimental**6. Time phase sequence of interaction patterns in small discussion groups.**

AMITAVA CHATTERJEE, Bangalore.

In small discussion groups there is a distinct relation between the time intervals of the 'manifest interactions' of the members and the rate of interaction. The interactions that occur during the observation period of time, is called here "manifest interaction". But in a residential group, outside the observational period, much more 'latent interactions' occur. These latent variables have much influence on the manifest content of the interactional field. And that is why the interaction rate increases with the passage of time.

The present paper is a further extension of the analytical study of a project on small discussion groups. Here the observations of one group, consisting of nine members, are reported. The members of the group were the participants in a fifteen-day residential study course. So, they had had enough opportunity to meet informally in a friendly atmosphere, apart from the observational periods. And so they developed more and more group cohesiveness as a result of 'latent interactions'. Thus with the span of the time, the distance between the interacting members in the 'psychological space' gradually diminish and so there is an increase in the rate of interaction. It is also found that with more of associations between the members the rate of agreement increases with the decrease in the rate of disagreement. In short, the following two hypotheses have been tested in the present paper :

1. The rate of interaction in the group increases with time;
2. The rate of agreement increases and the rate of disagreement decreases on the other hand, with the increase in the time of association.

7. Legibility of printed matter in Devnagri script.

NISITH RANJAN CHATTERJEE, Kharagpur.

A series of experiments were conducted in the laboratory to study the legibility of printed matter in Devnagri Script. The criteria for deciding whether a given printed matter is more readable or less legible were as follows :

DEPENDENT VARIABLE :

Objective :

- I. Error in identification of letters when exposure, distance, contrast, and illumination were constant.

- II. Threshold for recognition of letters. Minimum distance from which the letters were read correctly when other factors were constant.

Subjective (Measured in point scale) :

- (a) Ss' own report about ease with which the letters were read, or their distinctness.
- (b) Confidence in judgement.
- (c) Whether S wanted longer or shorter exposure to read.

INDEPENDENT VARIABLE :

Design (or form of the letter)—The standard Devnagri letter of news paper headline (26 point) were used in one series. Each letter was printed at the centre on rectangular cards.

A number of subjects of both the sexes were used in the experiments. The visual acuity of all the S was 20/20 or better. Their ages were between 27 to 32 years.

The general findings of the experiments are as follows :

1. The degree of legibility of Devnagri letters varies in different distance.
2. The degrees of legibility of all letters were not equal in a particular distance.
3. At different distances some letters tend to be confused with the others.
4. Some letters are more legible from a greater distance than the others.
5. The degree of legibility cannot be differentiated or compared beyond a particular range, i.e., when the letters are placed very near or too far from the subjects.

8. Learning and recall in hypnosis and the wake state : A comparison.

J. P. DAS, Utkal, Cuttack.

An experiment on the effect of hypnosis on learning and recall of meaningful material was carried out. Special regard was paid in the design to controlling factors like the depth of hypnosis, implicit cues from the hypnotist, attitude of the subject and meaningfulness of the material. Three somnambulistic Ss were verbally presented 15 paired words in 5 learning trials nonserially. The experiment divided into two experimental and one control session respectively tested waking learning by hypnotic recall, hypnotic learning by waking recall and waking learning by waking recall. Main results were recall deteriorated under hypnosis, and learning under hypnosis may be inferior, but never superior to waking learning. The first result supports theories with Pavlovian orientation which regard hypnosis as a state of cortical inhibition. The second result does not disprove predictions from that theory. The need of controlled experiments in the best traditions of experimental psychology was emphasized in this field as concluding remarks.

9. Stimulus-response compatibility and stress effects in a one-dimensional tracking task.

H. C. GANGULI, Kharagpur.

In perceptual-motor systems, S-R compatibility is a factor in determining the rate at which the system is able to process information. In a tracking task, for example, experiments have shown that the central-display relationship should be compatible for good performance. However, whether stress phenomenon is likely

to affect differentially the incompatible and the compatible control-display set ups has not been tested. The present experiment was designed to test the hypothesis that stress does affect performance under the incompatible set up more than in the compatible set up.

A one-dimensional continuous electronic compensatory tracking apparatus was used for this study made at the Laboratory of Aviation Psychology, Columbus. Two relationships (same and opposite directions of movements) between the control knob and the pointer of the tracking apparatus were used. Stress was experimentally induced by requiring the *S* to perform a secondary task of switch pressing according to a pre-arranged schedule. 30 undergraduate psychology students of the university served as subjects. Each was given 21 trials of 1 mt. each, 9 of these being with the secondary task. Performance was measured in terms of absolute integrated error scores.

Analysis of results showed the following: (i) performance was superior under the compatible set up; (ii) addition of the secondary task led to a significant deterioration in performance under both S-R conditions; (iii) no significant interaction between stressing task and the compatibility set up was seen. It is suggested that the hypothesis be tested on a more complex task and even if no interaction is noted at least the reasons for its absence may be better understood.

10. Is the expressive behaviour expressive?

RANJIT KUMAR MAJUMDER, Calcutta.

Studies on expressive behaviour have shown that there are differential performances of the two hands right and left, apart from the general characteristics.

We know every response is the resultant of many determinants, and arbitrarily we can analyse them into two classes, the adaptive and the expressive as proposed by Allport.

The hypotheses to be examined are—

- (1) expressive behaviour is consistent in a given moment and a particular set of movement are more capable than others; and
- (2) left hand being less subjected to exercise (unlike the left hander) is more consistent.

So far the first hypothesis, the data are indicative, i.e., the sense of all lines are consistently negative. Both hand conditions data are homogeneous—tested by analysis of variance. In both the cases the *F* is insignificant at 5% level.

Regarding the second hypothesis the observations are not decisive as the spread variation (SD) is practically invariant—it is below 5% level.

The shifting question both relative and absolute also could not put any evidence in favour of the second hypothesis. So to examine the second stand further investigation is needed.

11. An experimental study of "reflection time" as one of the conditions in concept attainment.

PRABHAT K. MUKHOPADHYAY, Calcutta.

It has been observed that correct concepts are discovered during the rest-intervals between the sequences of the experimental trials of that nature of operation. The assumptions here are made that these are not *Void-intervals* but an interval to be compared with the *incubation stage* in *productive thinking*. It is named as *Reflection-Time-Gap* (RTG).

With the help of associative-recall method, 10 non-sense words acting as *anchors* to 150 meaningful words, 10 groups of concepts are set to be attained. In between the trials, firstly 10", then 20", then 30" upto 180" gaps are prescribed. After each trial and the RTGs, a set of introspective reports are taken for all the 25 subjects. Then the analysis is done on the basis of number and the nature of the concepts attained.

It is concluded that the number and the nature of the concepts attained, progress to perfection in the increasing allowances of the RTGs. But the perfection in the true sense is never achieved though optimum achievements are shown. In this sense RTGs are denoted as one of the causative factors in the attainment of the new concepts.

12. A comparative study of the natural and emotional sets as the conditions of the "Blinding" effect in the process of anagram solution.

PRABHAT K. MUKHOPADHYAY, Calcutta and MISS INDIRA MALANI, Ranchi.

To consider then the effectiveness of the operation of a mental set in the problem solving situation as facilitating or inhibiting, effective conditions of the subjects are taken into account. Keeping accountable experimental conditions constant, two situations are created which, in the psychological sense are rewarding and frustrating. Ten sets of anagrams are required to be solved in the emotional situations described above and in the situations where no such sets are imposed. It is observed for the subjects in the above two experimental situations that in the former the production time and the SDs are much longer than the later situation. Also the final outcomes in terms of time for the two situations are observed as significantly different. It is concluded that whatever is the situation, any kind of emotional strain is not conducive for problem solution and for productive thinking.

13. Effect of temporal position of interpolated learning upon recognition.

A. K. P. SINHA and S. K. ROY.

The purpose of this study was to determine the effect of temporal position of the interpolated learning upon the recognition of the originally learned material. The experiment was conducted on 30 subjects under one control and three experimental conditions.

The findings were: (i) recognition of the originally learned material was adversely affected by the interpolated learning of an equivalent material irrespective of the point at which it was inserted; (ii) the interpolated learning of an equivalent material had its effect in increasing both the amount of omission of correct items and importation of new items irrespective of the point at which it was inserted; (iii) recognition was more adversely affected when the interpolated learning was inserted both immediately after original learning and immediately before recognition test than in the middle of the retention interval; (iv) there was no significant difference between the three experimental conditions in regard to the omission of correct items and the importation of new ones; (v) there was no significant difference in the magnitude of interference caused by interpolated learning occurring immediately after original learning and immediately before recognition test; (vi) no significant difference was found in the amount of both omission and importation of items in the insertion of the interpolated learning immediately after original learning and its insertion immediately before the test of recognition.

14. Phonetic studies in the Dravidian (Telugu).

C. R. SANKARAN and B. CHAITAYN DEVA, Poona.

There is really no one-to-one correspondence between acoustic (physical) invariants and phonemes. The definitions of 'Phoneme' according to De Saussure and Twaddell are discussed. It is pointed out that the phoneme is the mathematical structure of a physical reality. Any phoneme, defined as a mathematical structure, corresponds to any number of physical structures, the allophones, which maintain the mathematical structure an invariant. The phoneme can, therefore, be handled with our convenience of choice and it is through acoustic phonetics alone in terms of mathematical structures, Phonetics and Phonemics could be unified. Information Theory meets the lack of a description of systematic method for mapping a single phone in a given utterance on to a particular phoneme, while it is also possible to conceive 'distinctive features' of Roman Jakobson as 'normal (orthogonal) co-ordinates' in the manner E. Collin Cherry does. Our own attempt has been to establish the physical ('empirical') reality of the phoneme from the symbolic and conception levels of experience. There are structures or organisation at various 'levels'. Phoneme theory has, therefore, a bearing upon questions relating to 'existence' and 'non-existence'. The limits of time and its puncti-form origin form the measurable alpha-phonoid. Earlier P. C. Ganeshsundaram has demonstrated the 'vowel' which is the nearest physical approach to the alpha-phonoid from the view point of the 'Cascade Modulation Theory of Speech Formants'. In the present page, based upon the experimental data concerning the Telugu language, a newer way is indicated from the method of orthogonal polynomial fitting for measuring the alphaphonoid.

15. Quantitative mental estimations of various colours.

ARUN K. SIRKAR, Calcutta.

The present experiment had been designed to obtain the mental estimations of the percentage of colour present in a colour-white mixture as far as possible modifying the previous methods to avoid the error.

Three colour mixers were placed on the table side by side. Mounting a white and a coloured discs on the two colour mixers placed at both end and a mixture of colour-white on the central colour wheel, the subjects were asked to estimate the percentage of colour present in the central disc, supposing the coloured disc placed at one end possesses cent percent quality of that colour and considering the white disc as zero percent of colour. Three types of colours were used namely, green, blue and yellow.

The results indicated that the curves obtained by plotting the data were neither parabolic nor hyperbolic in nature but had tended to be nearly same as curves of growth and decay. The results did not corroborate in all respects with that of previous workers and the present author is of opinion that more researches should be carried on in order to obtain much emphatical conclusion.

PSYCHOLOGY OF THE DEVIATES**16. A study of the behavioural deviates.**

NIRMAL CHANDRA CHANDRA, Calcutta.

The present work is an enquiry about the behavioural deviates carried on some juvenile offenders who are kept at the Burdwan Vagrant Home of the Government of West Bengal.

The offenders were watched for days together in their setting and the behaviour pattern of some of them were observed and recorded. Then some 'behaviour situations' in writing and dialogue form were presented before them and their reactions were observed. Next each of the above offenders was invited to an open interview to know the plea which encouraged the young boys to be involved in antisocial acts.

It was revealed that the boys developed certain biological inefficiency in them due to the unhygienic nature of the social setting which hatched these antisocial elements. The present society (i.e. vagrant home environment) unlike the prior one, is a definite change and thereby the present study revealed the appreciable influence of this changed situation.

17. A case of compulsion neurosis.

N. N. CHATTERJI, Calcutta.

In this paper psychoanalytical materials of a compulsion neurotic patient was discussed. She developed the tendency to wash herself whenever she thought that her body had become polluted with faeces or dirty water. During analysis it was revealed that she had an unconscious desire to take excreta from male persons. This peculiar desire arose out of oral frustration. She had in her unconscious a phantasy that her mother did not give her enough milk but favoured her younger brother and so she developed jealousy towards him and it was later on displaced on her father and men in general. Faeces according to her was a product of milk after it had been digested in the body of the rival; so it was supposed to be as valuable as milk but it appeared to be dangerous also as it would contain the wrath of the rival from whom she wanted to snatch it. In her symptom also this ambivalency was noticed. Faeces polluted her as she wanted to possess it and she developed a tendency to wash it out as it appeared to be dangerous.

18. Aesthesiometric Index as a diagnostic guide of mental deficiency.

G. P. CHATTERJEE, Calcutta.

According to present practice, diagnosis of mental deficiency is arrived at after administration of intelligent test. Such testing sometimes does not produce real picture of the level intelligence of subjects because of the presence of subjective factor like lack of proper motivation. Drawback like this may be overcome if aesthesiometric index is taken as diagnostic guide of mental deficiency. In this study, it has been found that aesthesiometric index increases as level of intelligence decreases. Aesthesiometric index of normal, retarded, moron, imbecile and idiot are respectively 17.1, 19.11, 22.8, 28.6, 34.9. These increments in aesthesiometric indices are found to be statistically significant. This study has been done upon 25 persons—3 persons are taken from each of the 5 categories. Considerations for age and sex have not been taken into account. As the number of cases is not wide enough, this study should be treated as preliminary attempt and it always leaves rooms for further and much wider investigation so as to arrive at conclusive and convincing results.

19. A Psychological analysis of Indiscipline.

J. N. DASGUPTA, Calcutta.

Indisciplined behaviour is caused by frustration of needs not satisfied in the normal way. The frustration of need fulfilment impels one to seek alternative

normal objects and activities or substitute objects and substitute activities in order to meet the needs not normally satisfied. The behaviour purported for need fulfilment, when not acceptable to society, is characterised as indiscipline.

Apart from the physiological needs, the psychological need for security and affection; selfexpression; achievement and recognition is fundamental. Even the physiological need is ultimately psychological in as much as its frustration initiates psychological disturbance. And this psychological disturbance, emotional in character, impels one to activities not always acceptable to society.

If alternative normal objects and activities are not found for fulfilment of the frustrated or thwarted needs goal orientation fails due to emotions getting the better of reason and intelligence, when the mechanisms of Aggression; Regression; Suggestibility and Fixation play their part. In individual cases or even, on occasions, in group action, a sense of resignation appears when the person or persons lack even the minimum amount of aggression required to attack reality or are too rational to submit to the stress of emotions.

The frustrated person may also seek the security of mass power in crowd activity in which impulses normally controlled and suppressed by the individual are let loose.

Although a theoretical study this paper may supply hypotheses to experimental investigations as also clues to prevention and cure to Educational Practice.

20. Attitudes towards crime and criminal.

A. N. DEB, Allahabad.

The history shows that a wide variation exists in the attitudes towards crime and criminal. They have undergone radical changes because they are often built on superstitions, beliefs and conventions, religions and ethical concepts, moral standards and sentiments. The growth of understanding of the human mind, specially the working of the unconscious mind has brought about a revolution in the attitudes and the approach to criminals in the recent past.

A criminal reform and rehabilitation programme would achieve maximum success only when the majority feel and accept that the criminals deserve new forms of treatment. Because criminals have to be given an opportunity to reorient their pattern of behaviour and to live as a responsible member in the society.

About 500 adults of different ages, educations, professions and socioeconomic strata have been approached in this investigation. They have been asked to voice their feelings regarding the effectiveness of severe (common) punitive measures as means of reforming criminals and checking crimes.

The results indicate that people feel that criminal could be reformed. Traditional modes of inflicting severe punishment are not effective in most cases. However, there are difference of opinion and often equally strong contradictory views regarding the ineffectiveness of sympathetic attitudes of treatments as a means of checking crimes.

21. Four-fold cutaneous sense-response by 56 idiot subjects.

SUBIMAL DEB, Calcutta.

With the application of warm, cold, pain and pressure stimuli upon 56 idiot Ss the following phenomena had been observed :

1. Warm and pain sensations aroused unpleasant emotive state while the cold and pressure sensations aroused pleasant inferred from the S's behaviours during experiments with the above stimuli where responses had

been made through different aids due to inadequacy of verbal comprehension of the Ss.

2. Reported elsewhere by Tredgold and others that the idiot Ss show no reaction even to the severest pain and sometime remain expressionless with injury had been observed where 11% of the Ss actually remained unaffected to pain, 26% to warmth, 21% to cold and 33% to pressure.
3. Ilapazard and unexplainable movements had been found in 55% with warmth stimulus, 70% with cold, 60% with pain and 57% with pressure.

22. A comparative study of the performance of 'Normals' and Schizophrenics in Haufmann-Kasanin Test.

MYRA DEVI, Calcutta.

The present paper deals with performances of two groups of subjects, 25 normal and 35 schizophrenics in Haufmann-Kasanin Test. Instead of usual qualitative interpretations of the test performances, a quantitative scoring method has been introduced with meagre change in the method of administration.

From the test performances, subject's conceptional ability as well as his mode of thinking in course of solving conceptual problems could be assessed. Conceptional ability as ascertained from subject's success and failure in the test, has been effectively assessed in the present study, by introducing time limit in the test. A five point scale of rigidity-flexibility has been formulated on careful analysis of nature and varieties of subject's attempts to arrive at a correct solution. The scale effectively discriminates schizophrenic performance from that of normal.

Fluidity of thought has been ascertained by subject's inability to form clear concepts and also inability to carry on a concept once formed through completion. They give two sets of score. One of them, i.e. score for inability to form clear concept can effectively discriminate schizophrenic performance from that of normal. However the other set of score is less discriminative.

Apart from these quantitative scores few qualitative behaviour pattern during test performance have been noted which are found significantly high among schizophrenics. These are, making designs out of the blocks instead of arriving at a meaningful solution (which was done exclusively by schizophrenic patients) and aimless behaviour, (which was much predominant among schizophrenics compared to normal cases).

23. An experimental study of schizophrenic thought disorder.

E. I. GEORGE, Kerala.

Cameron's theory that Schizophrenics are 'over-inclusive' finds some evidence in the literature, whereas there is no conclusive proof for any abnormal 'concreteness'. Tests of concreteness and over-inclusiveness were given to the same schizophrenic groups. The therapy of over-inclusiveness is reformulated and a number of predictions are made.

The group consisted of 16 neurotics, and 18 schizophrenics properly matched. Of the measures on Nuffern intellectual speed and level tests, only two differentiated (5% level) and it was concluded that intellectual slowness is not an important aspect of schizophrenic thought disorder and could be hypothesised as a bi-product of over-inclusive thinking. Motor retardation was also not found an important characteristic of the present schizophrenic group as judged by the Babcock Psycho-motor tests.

Among the measures of concreteness only Goldstein-Scheerer Object sorting tests differentiated the groups significantly. This may be due to the heterogeneous nature of the material which favoured the production of unusual over-inclusive responses which are categorised 'Concrete' according to the Goldstein criteria.

Of the 13 different 'over-inclusive' scores differentiated well beyond the 1% level. Only 4 scores failed to differentiate, although the difference was in the predicted direction. These results support the theory that over-inclusion is a fundamental aspect of schizophrenic thought disorder.

24. Study of birth order and family positions of the criminals.

S. KUNDU and K. MUKHERJEE, Calcutta.

Understanding criminality is surely a complex task which gets enhanced when usually consumption of personality forces of the criminals are masked under the bounded rules of the prison.

In the present problem—Family position of the criminals as related with position in their sibship in childhood life—it has been stressed that, of many factors orienting criminality, past treatment from the family masters in the criminals' life is one, which has got some influence in socialising behaviour patterns.

120 convicts in the Alipore Central Jail were interviewed with special reference to their family discipline, parents' attitude towards them in childhood and adolescence, in relation to their respective birth-order. Some anomalies in their early life were noticed and in connection with their sibling position, it has become apparent, the issues occupying the middle position became the worst victim of unhealthy conditions (viz., negligence, undue punishment etc.) followed by other positions in the sibship.

Percentages showing the quality of treatment subjects received, reached high in 'negligence', 'indulgence' and both 'indulgence' from one and 'severity' from the other simultaneously.

So it may be stated, for prevention of further increase in crime-rate, children in home should be treated in a balanced way according to the demands of their psychical need and not the whims or idiosyncrasy of the parents.

24(a). An Experimental study of Alcohol and Drug addiction.

D. RAKSHIT and J. N. GUPTA, Calcutta.

The present paper is a part study of the long term project taken up by the author No. 1. The paper presents a brief report of experimental studies on fifty selected cases of Alcohol and Drug addicts. An attempt was made to study the Psychological factors in prevention and treatment of Alcohol and Drug addiction.

All possible therapeutical treatment were given in every instance. Every patient was given various forms of superficial psychotherapy, such as suggestion, persuasion, reassurance, in some cases, prolonged sedation and (sedation where necessary), occupational therapy, various forms of Physiotherapy and medical when indicated. Further, each patient received favourable influence of adequate rest, nutritious food and peaceful atmosphere.

On evaluation of the separate effects of various forms of therapy, one of the most suggestive findings in this study was that 36 of the 50 patients showed favourable results by psychotherapy within a brief period, averaging about a month.

SOCIAL PSYCHOLOGY**25. The Study of Cohesion in a Village Leadership Group.**

D. BAGH, Sriniketan.

The paper reports an experiment employed in examining a tentative hypothesis formulated by sociologists engaged in social research in an Indian village, by suitable objective methods.

It was claimed by sociologists at work that the cohesiveness of a group consisting of several young men was of such a high degree that the group surpassed the age old influence of factors creating social distance. The youth group was found to be extraordinary by the research workers.

Knowledge of the nature of the causes and conditions responsible for such cohesion was considered to be an interesting subject of a scientific study for sociology and social psychology. Accordingly, the following experiment was planned by the psychologist. In this experiment some members belonging to different castes were included. They were studied by different methods by the same psychologist :

- (a) All of them were interviewed individually.
- (b) They were observed in different group situations, while discussing informally various subjects and problems.
- (c) The degree of empathy in each personality was studied by the help of a rating scale.
- (d) A picture of socio-personal characteristics of each member was determined by the help of a questionnaire prepared out of the Personality Inventory of Bernreuter.
- (e) A comprehensive personality study of some members of the group was made by the Rorschach's Ink-Blots.

A few important points from the results obtained by this experiment are given below :

- (i) The cohesiveness of the group is not as strong and stable as it is supposed by the sociologists.
- (ii) On the whole the group is sufficiently integrated to discharge its responsibilities.
- (iii) The group could not really surpass the age old influence of prejudices. Such factors are influencing the group, but all its members are not aware of them.
- (iv) The integrity of the group was to a great extent due to the democratic approach of the leader in handling day to day problems; and also due to his keen practical social sense and fairly correct estimation of ego functions of members.
- (v) The most important contribution in the maintenance of group integrity was made by a fellow member of the inner circle who represents a neurotic personality picture.
- (vi) Potential disintegrating force is dormant in the group, but at the moment it is balanced by other forces mostly concerned with social values. Withdrawal of these forces or substitution of these values by other values may release the disintegrating force causing reshuffling of members in the inner as well as outer circles of the groups.

26. A study of the college teachers' attitude towards their authorities.

DEBABRATA BANERJEE and RAMANATH KUNDU, Calcutta.

A study has been undertaken by the authors to construct an attitude scale for the measurement of the teachers' attitude towards their authorities. A part study of the project, which is concerned with college teachers only, is reported in this paper.

A Likert type of attitude questionnaire was prepared after preliminary try-out, considering expert judgments. The final form of the attitude questionnaire was divided into two parts. The first part of it was meant for getting some informations like—age, period of service, status of the college, etc. and the other part concerned with ten attitude statements—six positive and four negative.

One hundred data from college teachers (professors and lecturers) were collected. From the quantitative values allotted to each category of response the total score for each individual in the attitude questionnaire was determined. Majority of the teachers, when over-all attitude was considered have shown unfavourable attitude towards their managing authorities. The relationship between attitude and other variables, such as—age, years of service, marital status, status of the college, etc. have also been presented in different tables. The results indicate the general factors which influence the attitude of the college teachers towards their managing authorities.

27. The measurement of attitudes of secondary school teachers towards the teaching profession.

M. B. BUCH, Baroda.

The purpose of this investigation is to discover the attitudes of the secondary school teachers towards the teaching professions; to determine the effect upon attitude of such different factors as :—1. Training; 2. Graduation; 3. Sex; 4. Experience, and to find out specially whether training has any effect in modifying their attitudes.

The investigation for the present problem was split up into two phases :

Phase I : Construction of an Attitude scale. Phase II : Applying this scale for carrying out the necessary investigation.

For constructing the scale, Thurstone's technique of "Equal Appearing Intervals", was used.

Conclusions are drawn at the end of the paper.

28. Interest pattern of postgraduate and undergraduate students.

R. G. CHATTERJEA, Calcutta.

The paper reports the results of an interest study based on the data obtained from 100 students of both sexes of which 56 were Postgraduate students while the remaining 44 were students of the various affiliated colleges teaching Intermediate and Bachelor courses. Interest in five dimension were studied viz. occupations, amusements, curricular subjects, activities and personality types. The items in the questionnarire were 48 for occupation, 41 for amusements, 41 for curricular subjects, 19 activities and 23 personality types. Subjects indicated their preferences by encircling one of the letters LID signifying 'Like', 'Indifferent' and 'Dislike' respectively.

Interest pattern of the two groups of subjects appears to have differed widely though in certain cases they are alike. The present work is however a part of a bigger project and hence no inference is drawn.

29. A study of temperamental qualities necessary for teaching profession at the University level.

MAYA DEB, Calcutta.

This is an attempt to determine the qualities, which are necessary for an individual to be successful as a Teacher in the University. Attempt has been made also to attribute quantitative measure to each of these qualities.

The previous investigations on this topic in the field of education endorse the fact that there is a peculiar set of qualities which distinguishes a good teacher from a poor one. With the help of these studies and with the help of N.I.I.P. (London) Temperamental Questionnaire Form, a questionnaire is prepared which contains a list of 25 temperamental qualities. These qualities have been expressed in positive form. The respondents were asked to give their opinion on the degree of desirability of such temperamental qualities on a five point scale to be an effective teacher. The questionnaire is an open end type. These questionnaire were then sent to about 175 educationists. The result thus obtained was computed with the help of Likert's scaling technique. It is found that among all the qualities 'sincerity' occupies the first place then comes 'Impartiality' and 'self-discipline'. Other qualities occupied next positions in order of their importance for the profession.

30. A study of intelligence scores and rural-urban residence.

MOHAN C. JOSHI, Banaras.

Under the Government of India's Humanities Research scheme, the author constructed and standardised a verbal 'spiral-omnibus' type of group test of general mental ability in Hindi (31/55). The present paper tries to investigate the influence of rural urban environment on the test-performance of a randomly selected sample of 755 boys (rural : 415; urban. 340) from Banaras and Almora respectively, studying in VIII to X classes.

On the analyses of the data, it was found that statistically significant differences existed (significant at .01 level) in the test-performances of the rural and the urban boys, the urban boys doing better than the rural ones. On exploring the possible factors responsible for such a difference in the respective environments, the following came to light :

1. Psychologically significant objects are found differentially in the real and urban environment.
2. Rural environment is not capable of inducing the type of ability demanded by the verbal test of intelligence. The plain, relatively homogeneous rural environment puts no premium on vocabulary, speed of work, competitiveness, quick adjustments, and abstract thinking type of mental functions.
3. The urban environment is more advanced educationally, culturally, and hence the general social stimulation, and cultural milieu motivates the urban boy more than his rural cousin.
4. The length of school term is shorter in the rural area due to the impossible conditions of the roads during some seasons, crop time, seasonal and other local engagements also reduce the working days of the rural school.

31. A study of intelligence scores and caste-differences.

MOHAN C. JOSHI, Banaras.

A verbal, 'spiral-omnibus' type of group test of general mental ability in Hindi (34/55) has been constructed and standardised by the author. In the present paper

a study of intelligence scores and caste-differences among the testees has been made on a randomly selected sample, of 678 boys of VIII to X classes in Banaras and Almora.

On testing the significance of difference in the test-performance of the testees of the different castes, it was found that the difference in test-performance was significant at .05 level between Brahman and Kshyatriyas, and Brahman and Vaishya boys, the latter faring better than the former in both the pairs. Rest of the inter-caste differences seemed to be insignificant statistically.

Assuming that the operation of caste-differences and prejudices may also depend differentially in the urban and rural samples, we analysed the rural sample (362) and the urban sample (312) separately, and found that there existed practically no difference in the test performance of the testees in the rural area as well as the urban area. (All the CRs were below .80).

Therefore, we conclude that as far as general mental ability is measured by the present test, there does not seem to be any significant difference in the test performance of the boys belonging to the various castes in the rural or the urban area. This adds to the merit of this test of general mental ability.

32. A study of Social Background and College going Tendency of Secondary School Pupils.

PRAYAG MEHTA, Surat.

The investigation studied five hypotheses namely: The college going tendency is normal and there is no reason for any worry. It is the function, of fathers' occupational class; of fathers' educational levels; of pupils' intelligence and of sex. Data were collected through a questionnaire from a sample of 1,058 boys and 307 girls of Surat. Results were checked by F and t-tests. The F values for sex (in favour of boys), intelligence and occupational class (for boys) respectively were 5.7, 6.9 and 3.9, all significant at .01 level. It was not significant for educational levels. t-tests showed boys from professional, salaried employees and farmers significantly different from other classes. Pupils with superior intelligence differed from others but the just above average and average did not. It was concluded that the tendency was widespread; occupational class and intelligence affect it; boys showed greater tendency and fathers education did not affect it. Results indicated need for proper school guidance programmes.

33. Attitude of School teachers towards Sex-education.

PROKAS CHITTA NANDI, Calcutta.

The problem was to survey the opinion of the hundred school teachers regarding the adoption of the Sex-Hygiene and Sex-Science by the questionnaire method on the five point scale each of which was arbitrarily weighed and which was selected by a pilot survey of twenty-five recognised school teachers with adequate teaching experience and with the minimum academic qualification of graduation. Final selection of the items were made with the help of efficient Scientists in this line. The scoring method of W. J. Goode and P. K. Hatt was followed. The nature of the graph plotted from the entire data obtained from the scores of the teachers, showed the definite inclination of the teachers towards the utility of Sex-education of the school-age children. The co-efficients of correlation were very high and they proved that the decision of the teachers were actually reliable and valid and were really pivoted on the issue of Sex-education.

34. Scoring samples of Indian children on the Rosenzweig P-F study.

UDAI PAREEK, New Delhi.

An adaptation of the Children's Form of Rosenzweig P-F Study was prepared for Indian children and standardised on a population of about 1,000 children of ages from 4 to 13 years. The responses from children were got in Hindi and the closest English translations showing scoring samples are presented here. In scoring guidance was sought from the scoring samples mentioned in the original manual. There were, however, occasions when the author was doubtful regarding the scoring of some responses, because either the investigator was not satisfied with the scoring factor as indicated in the original manual or a typically new response was got. In such cases the responses were referred to Dr. Rosenzweig for his comments. Some very interesting and new responses were got from Indian children. The largest number of new responses were those which involved more than one scoring factors and were, therefore, included under 'combinations.' Some new types of pure responses were also got. For example in situation 10 super-ego scoring factors are not found in the original manual, but responses involving these factors were got in some protocols under study. New sets of combinations were got in a large number. The various novel combinations and typical new responses are mentioned and discussed.

35. Developmental patterns of Rosenzweig P-F study variables in Indian children.

UDAI PAREEK, New Delhi.

Analysis of the responses received on the P-F Study reveals some clear trends in child development in India. As far as the categories are concerned, extrapunativeness predominates all age groups, as also ego-defensiveness. From the point of view of scoring factors E and i seem to be important at all age levels. The two super-ego patterns that seem to dominate at all age levels are E-E and M+I, which shows a tendency of accusing oneself and others being important factor in the child's life.

A definite trend in the decline of extra punitiveness with the increase in age is revealed. Steady rise in Group Conformity Rating scores with increase in age is also revealed, indicating increase in conformity to group behaviour with an increase in age.

As for the factors, e declines with advance in age. However, a bi-modal picture is provided in this case. At the age level 8, the figure for e reaches very high and then suddenly declines at age level 9. It seems that the tendency to expect a solution from others is characteristic of the age levels 4 to 8 and the child at 9 years of age becomes more independent. This becomes more clear when considered along with the change in i. There are other interesting changes visible in super-ego factors. These changes reflect the influence of socialisation on the child.

36. A measure of attitudinal conformity derived from the 'J-Curve Hypothesis.

J. C. PRAKASH, Bangalore.

In this paper it is shown with the data derived from an attitude questionnaire that the statistic β_1' may be made use of as an index of attitudinal conformity.

The attitude questionnaire is made up of 100 generalised statements, fifty of them worded in the positive, favourable direction (F-scale), and the remaining fifty worded in the negative, unfavourable direction (U-scale). The S is required

to particularize the given statements by indicating, according to his opinion, the 'relevance' of these statements with respect to selected groups or communities including 'OWN' community.

It is shown that the J-curve gives a good fit to the obtained distributions both on the F-scale and on the U-scale, when these distributions represent the Ss' attitudes toward 'OWN' community.

β_1 , the index of conformity derived from the J-curve hypothesis is found to be relatively small for the F-scale distribution and relatively large for the U-scale distribution.

Some of the theoretical implications of these results are discussed.

37. Effects of schooling on abilities and attainments of the High School students at Aligarh.

K. RAY-CHOWDHURY, Aligarh.

The present paper reports an investigation carried out in 1958-59 under the supervision and active participation of the author by his Ph.D. student, Raj. K. Ojha, who has been working on "Intelligence and Intellectual Stimulation during Adolescence". In the present investigation, six tests, namely Vernon's non-verbal 'g', Vernon's Block Design, Vernon's Drawing Pattern, Vernon's Graded Arithmetic, Raven's Progressive Matrices, and Ray-Chowdhury-Ojha's Verbal Intelligence (Hindi Version), were administered on 150 (10th class) students, 50 from each of the following schools at Aligarh : D.A.V., Paliwal, and Barasani Inter Colleges. The students were socio-economically matched.

The raw scores were then normalised, and then the significance of the mean differences between the schools on each test was studied with the help of critical ratio technique. As the reliability and the validity of the above tests have been found fairly high, it would be rather valid on our part to account for the differences obtained in terms of stimulating and non-stimulating schools at Aligarh.

38. Group differences in personality traits within a University.

K. RAY-CHOWDHURY, Aligarh.

The present paper reports the results obtained on the same sample and with the same tests as described in the paper on "Typological Relationship between Various Personality Assessments" (cf. *Abstracts Part III*, this issue of the Proceedings of the Association). Four post-graduate researchers, namely Alay Ahamad, Tariq Sultan, Mahamood Siddiqui, and Jamil Murtaza carried out the investigation under the supervision and active participation of the author.

The enquiries of differences involved grouping of the above subjects (*plus* a new group of B. Ed. students, Male=46, Female=24) into the following : occupational groups at the college level; religious (Muslims and Non-Muslims including only Hindus and Christians) and caste (Shias and Sunnies); provincial (Uttarpradesh and Non-Uttarpradesh); rural and urban; father's income and the stipend the student was drawing every month; birth-order and age-groups.

The significance of the mean differences of the above groups were studied with the critical ratio technique, and the results are at places definite contribution to our knowledge of various group-differences within a university.

39. A microanalytic study of participation in seminar discussion group.

P. S. VIVEKANANTHAN, Bangalore.

The present paper reports the study which forms a part of a larger project aimed at evaluating a short term management training course. An attempt is made here to develop a method of assessing the effectiveness of the seminar-type discussion sessions. The method employed is similar to that developed by Bales and others at Harvard. This method is termed the Microanalytic method for the analysis of participation in group discussion sessions.

In the group discussion sessions that were studied here we found evidences of monopolistic tendency on the part of a single member as well as a high degree of consistency of participation among the members of the group as a whole. It was also found that a large part of the discussion sessions was devoted in seeking clarification of the problem set for group discussion.

INDUSTRIAL PSYCHOLOGY**40. A Work Study Technique for Non-Repetitive Work : Development, Reliability and Validity.**

B. S. BHAGOLIWAL, Calcutta.

Work study is one of the chief techniques of scientific management, and is well established in businesses and industries where repetitive work is predominant. However, there is an increasing need for the application of work study principles to non-repetitive work. This paper deals with the development of a new work study technique for non-repetitive work, using motion study charts and symbols. An empirical investigation using this technique was carried out to determine its reliability, validity and applicability. In the investigation, four different jobs were analysed; those of research scholar, stenographer, office helper and laboratory assistant. The work study data were collected by the workers themselves on their regular supervisors. Both intra-worker and inter-worker reliability were determined, i.e., consistency for one worker over time, and agreement between different workers on the same job. Validity was found by correlating the results of this technique with those obtained by work sampling. The results indicate a high degree of intra-worker and inter-worker reliability for the different jobs tested, and considerable validity for many jobs. However, further investigation is required to establish this as a general feature of the technique. The technique was also found useful for comparing the performances of two or more workers on the same job. Psychometric concepts of reliability and validity were found to be appropriate for work study observations, and their application illustrated.

41. A Motion and Time Study Experiment : Usefulness for Redesigning Workplace Layouts and Observer Reliability.

K. P. BHATTACHARYYA, Calcutta.

Motion and Time Study is one of the modern techniques which have contributed much to present day industrial progress. Designing the workplace layout so as to eliminate many unnecessary movements can be accomplished by a systematic application of this method. While motion and time study technique has frequently been applied by engineers, the question of observer reliability requires the atten-

tion of psychometricians. The present experiment had a two-fold purpose : (i) to determine whether redesigning the workplace layout (of a duplicating machine) on the basis of motion and time study would significantly reduce movement; and (ii) to find observer reliability or degree of agreement between observer using motion and time study charts.

Data were obtained by three observers in the old workplace layout. On the basis of this data along with a prolonged study of the floor diagram of the workplace, the new layout was suggested and the operator was studied again in the new workplace layout by the same observer. Applying the 't'-test it was found that frequency of movement, time spent in movement, and distance moved were reduced significantly in the new workplace layout. Percentage agreement between observers ranged from 78 to 86%.

42. Personality—Structure and work efficiency.

SAMIR KUMAR DEY, Howrah.

There is a great need of basic analysis of the characteristic of the worker and his work efficiency. The major points to consider are the extent of individual differences of workers in similar jobs and the variability in production or efficiency. The present paper is based on a research study amongst two groups of workmen and group engaged purely on mental work and the other group on physical work. These two groups have been further sub-divided into low efficiency and high efficiency group. In the nature of work which is chiefly associated with mental phenomenon the following categories of workmen are taken—accountants, typists, clerks dealing with labour statistics and paysheet clerks. As regards the physical work different categories of Jute Mill workers from different departments doing mainly physical work are taken and also some Rolling Mill operators.

A proforma on the personality traits was applied on the subjects mentioned above.

The results show that there is a high positive correlation between the personality structure and efficiency.

The following table will indicate the results.

Mental Work.	Personality Structure.
Higher efficiency Group	Inclination towards more INTROVERT TYPE non sociable, submissive.
Lower efficiency Group	Inclination towards more EXTROVERT TYPE, sociable, leadership trait.
Physical Work.	Personality Structure
Higher efficiency Group	Inclination towards more EXTROVERT TYPE, sociable, leadership trait.
Lower efficiency Group	Inclination towards more INTROVERT TYPE, non sociable, submissive.
Personality Structure	

Actually much more research work in this field is needed before the results can be taken out of the theoretical realm. This research is of much importance to Personnel Manager, Employment Exchanges for selection of proper persons for proper job.

43. Effect of some psychological incentives on production.

SAMIR KUMAR DEY, Howrah.

Production is one of the most widely used criteria to determine industrial efficiency and is also used to determine wage rates. The question of production has received vital importance to-day and various research are being carried out to increase the national production of our country. Man behind the machines is considered to be more important than the machines. The sum total of man's condition upon the work has therefore a high correlation with their production incentives which generally heightens the work curve and of two main types—physical and non-physical. Amongst non-physical—psychological incentives play a major role.

Though monetary incentive is supposed to be the major factor in increased production and efficiency in almost all the Indian Industries but still a study on some Psychological incentives in the Weaving department of a reputed Jute Mills has shown positive results.

The few Psychological incentives that have been used are as follows :

- (i) Cordial supervisor-worker relation.
- (ii) Visit of the Labour Welfare Officer in the department with words of encouragement.
- (iii) Spot enquiry by the Labour Welfare Officer in case of trouble or accident.
- (iv) Solve of workers' problems by the Labour Welfare Officer and Supervisor.
- (v) Words of encouragement in case of low production rather than disciplinary actions.
- (vi) Listen to the workers' difficulty with sympathy.
- (vii) Facilities to workers.
- (viii) Announcement of names of good workers through the representative in the Works Committee.

The workmen in the Weaving department being piece rated their production has been studied through two main sources keeping the normal average production in view (a) Rise in production with regard to cut pieces, (b) Rise in the weekly wages.

The work curve rises up and remains steady but there is a reverse result with disciplinary action the work curve shows a spurt but after some days again falls. Repeated disciplinary action with the workman concerned will not improve his efficiency but will make him a problem worker inside the department.

Production therefore depends on the sum total of environment forces as also psychological motivations and incentives. The factors considered here has nothing to do with the complexity of work but has been taken on a general level with all subjects engaged in the same pattern of work.

44. High and Low in Engineering Education : The Problem of Criterion.

CH. H. K. MISRA, Kharagpur.

In order to segregate the "high & low" in Engineering Education, the suitability of examinations as the criteria was considered. The concordance coefficient between the ranks of three different examinations of three different engineering

Departments were calculated to see the randomness of the ranks. The concordance coefficient were also significant (W.C.E. .6734 W.E.E. .6633 W.M.E. .4934) but not sufficient to justify the pooling of the ranks of the said examinations. The rank difference correlation of two of the above examination was calculated for each of the Departments and were found to be sufficiently high (Rho CE .80, Rho EE .86 Rho ME .88). It was therefore concluded to pool the ranks of these two examinations. After re-ranking the students in the sample on the basis of the pooled ranks, the extreme groups would be segregated. These have to under-go further screening by teacher and peer ratings.

45. Some intra-organizational problems affecting employer-employee relations.

J. C. PRAKASH and A. CHATTERJEE, Bangalore.

This survey project was conducted in four large-scale, private-sector industrial organisations located in and around Bangalore City.

We have focussed here on problems intrinsic to the work-situations *within* the organization rather than on 'Union-Management' type of problems. The basic assumptions involved as well as the method employed are described.

It is found that for the majority of the rank and file workers, their *psychological space* and *time perspective* are both limited in range. It is shown that the problem of employer-employee relations in an organization needs answer to the question: "What are the reasonable returns the employee expects for the work he performs and the services he renders to the organization?"

The results of this survey suggest that the relations within the organization are to a large extent conditioned by the degree to which the following six basic expectations of the worker have been fulfilled:

(i) *Job-conditions*: The worker expects the conveniences necessary to do a good job and to derive the satisfaction out of doing a good job.

(ii) *Supervision*: The worker expects effective, but not excessive supervision.

(iii) *Wages*: The worker expects his wage-earnings to be at least in conformity with the actual 'worth' of his job and his capacity to work.

(iv) *Supplementary earnings*: The worker, generally, expects to have opportunities for supplementing his normal earnings.

(v) *Auxiliary amenities*: The worker expects the organization to provide at least a minimum of amenities.

(vi) *Right of appeal*: The worker usually expects that some one in formal authority in the organization would listen to his grievances.

The fulfilment of the above-mentioned six basic expectations of the worker is the pre-requisite for promoting harmonious employer-employee relations.

46. An examination of the unidimensional concept in the Study of Work-Values.

K. M. SRINIVAS, Mysore.

Several investigations regarding the work-values have been carried out both in educational and industrial fields. The typical experimental design has been that of having the job-values ranked in order of preference using either the inventive or the selective method. The question has been raised by the author whether the data lend itself to a ranking treatment. An attempt has also been made to answer the question by using the paired comparison response scaling model under Thurston's different approximations of the law of comparative judgment. The scale values arrived at were tested for unidimensionality by applying Mosteller's chi-square test. The presumed linearity of the varieties was found to be untenable at a high level of significance.

EDUCATIONAL PSYCHOLOGY**47. Some observations on the use of W.B. Adult Intelligence Scale in India.**

H. S. ASTHANA and T. S. DHAPOLA, Lucknow.

The paper presents an analysis of the performance of university students on W.A.I.S. In most cases, contrary to common expectation, scores on the verbal section were appreciably higher than those obtained on the performance section of the scale. Scores on various subtests of the battery have been analyzed and the structure of the sub-tests has been examined in the context of the demands they make upon the respondent. The findings are interpreted in terms of the test structure and the educational and cultural frame of the subjects.

48. Validity of personality trait ratings of High School Students by their teachers.

TAPAN BASUMATI, Calcutta.

The object of the present study was to see how far, under the existing conditions, our high school teachers were really able to make differential trait ratings of pupils' personality.

Thirty-six Bengalee boys of 16-plus reading in the tenth class of a government high school in Calcutta were rated by three trained teachers independently on twenty personality traits (like persistence, concentration, emotional stability, laziness, sociability, carelessness etc.) with the help of a specially devised rating scale. Care was taken to minimise chances of error, specially the notorious halo error.

Reliability (found by intra-class correlation technique) of trait ratings (summed ratings of three raters) was seen to vary from .82 to -.26. Ratings on sixteen traits (four being excluded for obvious reason of unreliability) were then inter-correlated. All the correlations were spuriously high ranging from .93 to -.96, which suggested contamination of ratings by a strong halo effect. Correlations of ratings with the scaled marks obtained by the students were also found similarly inflated. But when achievement was partialled out, 60% of trait inter-correlations become insignificant.

It is concluded that the validity of teachers' ratings is doubtful as they are in all probability a reflection of the students' academic performances.

49. Construction and standardisation of achievement test in Geography for Std. VIII (Gujarati)

SMT. SAROJINI D. DESAI,

The needs for Achievement Tests in Secondary Schools is quite obvious and much felt. In the present work, the investigator constructed and standardised the achievement Test in Geography for Std. VIII. The objectives were to construct and standardise the test, to study the performance of the schools of Gujarat and to study the causes of low achievement in different sub-tests and to find out suggestions for that. The Diagnostic value of the test is its significant feature. The major purpose of this investigation is to help the current (which has started by this time) of eradicating the defects in the present examination system. This will help the teachers to give thought to the new type of objective measurement. The present test helps the teachers to apply this test and to find out the effect of his teaching, to find out the weakness of the pupils, to compare the achievements of the pupils with other pupils and also to compare the relative achievements of the

same pupil in different sub-tests. This work was submitted as a part fulfilment for the M. Ed. degree of Faculty of Education and Psychology, Maharaja Sayajirao University of Baroda.

50. Progressive matrices test applied to a group of Secondary School going children in Gujarat.

D. B. DESAI, Baroda.

The needs for the Intelligence Tests in Gujarat is much felt. And more so, about the non-verbal group Tests of Intelligence. Progressive Matrices Test (Revised order—1956 version) is a non-verbal group Test of Intelligence. Each problem in the scale is really a 'mother' or 'source' of a system of thought—hence the Name Progressive Matrices. The Test is prepared by J. C. Raven in England. The Investigator applied this test to the secondary school going children in Gujarat with a view to study the validity and reliability of the test, to find out the norms for the age groups 13+, 14+, 15+, 16+, 17+, and to find out the discriminative and difficulty value of items. The results obtained are quite interesting. The test is found to be quite convenient to administer. The test is reliable and valid. The different types of norms i.e. age wise, area wise, grade wise norms are found out, and items A1, E11 and E12 are not found consistent in the test. *As far as the Revised order of 1956 of Progressive Matrices Test is concerned, this work is the first of its kind in India.*

51. Reactions of Faculty to Examinations Reform.

V. K. KOTHIURKAR, Poona.

Government of India have started the Indian Examinations Reform Project under which, recently, a number of Seminars were conducted on Evaluation problems and examination methods. The author of this paper participated in a number of these seminars both at home and abroad in United States and U.K. The paper summarizes reactions of the Faculty members observed in these seminars and discussions.

Persistent challenge of examination research to be clear and explicit on our educational objectives provoked some of the strongest and most varied reactions, from explaining away the problem as a needless Americanism and outright denial of the necessity to specify course objectives to the most brilliant and analytical formulations of the same. Generally there was a growing realization of the need to define objectives. However considerable difficulty was experienced in implementation. Often times the reaction of the Faculty members took the form of resorting to limited palliatives like internal assessment in part or valuation by two judges etc. instead of undertaking a basic examination of our educational purposes, teaching and learning practices and evaluation procedures. There was however, some awareness of the crucial role of examinations which could not be tackled in isolation from broader educational issues. Two contrasting but equally dangerous reactions were sometimes clearly noticeable (1) complacency (Our teaching and examination methods are the best possible), (2) defeatism (Our resources are hopelessly inadequate, our teacher-pupil ratio is adverse etc. and no reform is possible how-so-ever desirable and urgent it might be).

A constructive approach is recommended. We are under obligation to relate our means to our ends and find a way, here and now of functioning more interestedly, conscientiously and efficiently as teachers and examiners.

52. A Study of the Body Image.

RAM MURTI LOOMBA, Lucknow.

The author presents the results of a study of the body image based on data obtained through the administration, to university students of Psychology, of his new type of sentence completion described in an earlier paper (Ind. Sc. Cong., 1959, Delhi).

53. Modification of conventional scoring system in examination suggested.

AMAL KUMAR MALLIK, Calcutta.

The traditional essay type examination is generally criticised on the ground that it is an unreliable instrument for the measurement of pupils' educational achievement. The present system of scoring is one of the contributory causes of this unreliability. It may, however, be reduced to some extent by introducing a few modifications into the current system, as proposed in this paper. Raw scores (i.e. the marks awarded by examiners), which by themselves have no practical meaning and which lack in comparability, are to be transformed into T-scores and equivalent scores. It will bring about some amount of reliability in measurement of pupils' educational achievements and enable us to assess and compare them as correctly as possible.

The raw scores in M.I.L. (Modern Indian Languages), English, Mathematics, Classics, History and Geography of 160 pupils constituting a representative sample of a population of 1,600 candidates appearing at a certain public examination have been considered. Sample statistics have been computed to use the formulae of T-scores and equivalent scores. The data have been treated both graphically and analytically. The raw scores of 10 pupils securing highest total marks have been converted into T-scores and equivalent scores. Their rank positions as determined from the scores thus obtained have been compared with their original positions to show the effect of the suggested modifications.

54. Handwriting scale in Gujarati script.

M. M. PATEL, Baroda.

Problem :

The aim of this investigation was to determine the quality of handwriting in Gujarati Script with regard to various age levels i.e. from five years to sixteen years and seeking if possible any sex difference.

Procedure :

For this investigation few Gujarati Sentences neither too difficult nor too easy were selected including all the alphabetical letters in order to maintain the clear idea of the formation of different letters. These sentences included all the consonants and basic vowels without using any Conjunct letters.

To determine the norms for the qualitative aspect of handwriting, 2,011 boys and girls ranging in age from five to sixteen years were selected from 40 pre-primary, primary and secondary schools representing all the various localities of rural and urban areas of Gujarat. These 2,011 scripts were rated independently by five competent judges on the basis of seven characteristic like slantness, linearity, letter formation, uniformity of size, spacing, neatness and general impressions. Then Average means, Standard Deviation and Percentile scores for both

the groups were computed. Level of significance was computed for both the groups separately in relation to their successive years.

Conclusions :

(1) The average means of both boys and girls were increasing from 5 to 16 years except for the boys group of 14 years as well as that of 18 years girls—where there is a slight decline in their progress.

(2) The mean difference is significant for the age group of 13 years boys alone. This clearly shows that 13 years old boys have superior quality of handwriting to those of girls while at the other age levels there is no significant difference between the average handwriting of boys and girls.

(3) There is a definite improvement in the quality of handwriting from year to year. This fact is evident from the critical ratios between successive ages except the age groups of 5-6, 7-8, 10-11, 11-12 and 13-14 in both the cases of boys and girls.

(4) The differences between the means at successive age levels are significant and hence we can say that the quality of handwriting improves from year to year.

Further, this investigation can be useful in educational field as follows :—

(1) Such a scale will enable the teacher to determine the Handwriting Age of any pupil by the following formula.

$$\text{Handwriting Age} = \frac{\text{Handwriting Scale Age}}{\text{Actual Age (Chronological Age)}}$$

This Handwriting Age will give an idea whether the handwriting of a boy or a girl is poor.

(2) Such a scale can be used for comparing the handwriting of various school-classes.

(3) It may be also helpful in educational experimentation for forming equivalent groups (i.e. quality of handwriting equal for both groups). For instance we can compare whether daily practice for 30 minutes improves the handwriting of a particular class or pupil. We can also determine the effect of using fountain pens (during the earlier days of development) of the quality of handwriting.

GUIDANCE AND SELECTION

55. A Study of Prediction of College Students' scholastic success by using (1) Earlier scholastic success and (2) Voluntary interest in the subjects as valid predictors.

S. V. KALE, Poona.

Hypothesis : Scholastic success is assumed to depend on two factors :

(1) *earlier scholastic success*, as the maxim says : "Nothing succeeds like success; and (2) *degree of interest in the subjects and in working for it*. *Greater the earlier success, greater is the voluntary interest stimulated in scholastic pursuits; and greater the interest so stimulated, the surer is the later success.*

Procedure : Earlier scholastic success of 240 students (159 male and 81 female) at F. Y. Arts Examination in 1953 was rated by impartial judges into three grades : Grade A, Grade B, Grade C, and the number falling in these grades was obtained. Similarly, these 240 subjects were classified by impartial teacher judges into three groups of three degrees of interest. Thus the degrees of interested were also rated as A, B, and C.

The data (1) for boys and girls combined, (2) for boys only and (3) for girls only was treated by the X^2 (Chi-square) by contingency three-way table method was computed. 1.—For df- 4 the Chi-square obtained i.e. 24.81 is significant at .01 level of confidence.

Conclusions : The association revealed in earlier success and degree of interest is not merely by chance. Also (1) More number of brighter students may be experiencing loss of interest. (2) Good students (as contrasted with brighter students) acquire more interest in the subject; poorer students do not, their interest being seemingly damped by previous failure. (3) Rarely do brighter students lose interest completely. (4) Girls seem to apply their mind to the subject more, even though they might have met serious failure in the earlier period.

56. Vocational Choice Making Tendency of Secondary School Pupils.

PRAAYAG MEHTA, Surat.

This questionnaire study of 1,600 pupils reading in Stds. X and XI report data regarding their vocational choice making tendency in relation to their fathers' occupational class, educational levels and intelligence. Results were checked by F and t-tests. The t values for boys of Stds. X and XI (in favour of former) was 4.6; boys and girls of Stds. X=4.2; boys and girls of Std. XI=1.6; girls of Stds. X and XI=1.1. The first two were significant at .01 level. The rest were not significant. F values for occupational class and educational levels were not significant. F of 3.8 for intelligence was significant at .05 level. Pupils having I.Q. 131 and above showed better tendency than others. Pupils from lower I.Q. categories did not differ. Results, surprisingly, showed X class boys better than XI class boys. This, and the sex difference indicated the need for comprehensive theory of Vocational Choices of Indian pupils. Some points have been raised and discussed in this regard.

57. Standardisation of a "Study Habits' Inventory" for the University Students in Gujarat.

D. S. PARIKH, Baroda.

Aim—The problem of study habits of students has drawn attention of many Psychologists and Educationalists. The broad conclusion is that of improving study habits help in improving the students achievements. So this problem was taken for investigation.

Procedure—To start with the problem the author had interviewed few students those having high and low percentages of marks attained at their annual examination and on these basis 46 items in Gujarati were constructed. This try out inventory was administered to a representative sample of 185 students selected from the various faculties of the M. S. University of Baroda viz. Arts, Science, Commerce, Technology, Home Science and Intermediate College in proportion to the total strength. Scoring was done on the basis of five point scale. The Biserial γ methods of 27% upper and lower groups was adopted for the item-analysis and the discriminating index was found out by applying Flanagan method.

Those items whose Biserial γ s were about 0.25 or more than that were selected for the final inventory. This final inventory consisting of 38 items is splitted into four categories of study habits, viz. Reading and not-taking; Habits of Concentration; Distribution of time and social relationships; General habits and attitudes of work.

The final inventory was administered to a group of 600 students coming from rural and urban areas of the various faculties of the M. S. University of Baroda. After that the reliability of the test was calculated by using retest method of a small group of 50 students and correlation was found out.

Conclusion—Applying the statistical formulae the following conclusions were drawn :

1. The reliability of the Inventory is 0.924.
2. The female students have better study habits than the male students.
3. There is no significant difference between the students coming from rural and urban areas.
4. There is a normal distribution of the study habits as the curve is slightly *Platycurtic*.
5. There is no significant difference between students of various faculties in their study habits.
6. Individual students vary in their study habits.

58. Counseling as a Learning Process.

A. K. P. SINHA and S. N. SINHA, Patna.

Uncertainty, as it has been experimentally demonstrated by Sinha, A. K. P. produces anxiety. Individuals often suffer from a sense of anxiety about their health, success in the examination or proper adjustment in the social world. And although they appear to be minor and temporary in character, they frequently lead to severe personality disorders. Counselling is, therefore, essentially needed to help such people for the amelioration of their problems. The primary aim of counseling is to help the individual seeking assistance to resolve his difficulty by giving him improved insight into his conflicts and adjustments. It is principally centred around the problems and needs of the client. It is a process by means of which the counsellor enables the client to understand himself in appropriate perspective in the context of his social and physical environment.

Counselling is essentially a process of learning. The major function of the counsellor is to help the client realise himself and so regulate his behaviour that he may develop a wholesome personality and lead a more happy life.

In conclusion, it has been suggested that counselling can no longer be regarded as a process that can be understood in isolation of such psychological functions as motivation, perception, learning, etc.

59. Sociological and Psychological Factors in Success of Engineering Factory Students.

DURGANAND SINHA, Kharagpur.

In spite of highly selective admission to engineering institutions, there are still "failures" and "laggers". Intelligence and aptitude tests touch only the peripheral qualities and are useful for selecting personnel for simpler vocations. But prediction of success in complex social situations requires the knowledge of the situation in which the individual is to work and of the motivational factors essential for effective functioning in such a situation. The neglect of the latter has made the prediction of success unreliable.

An engineering institution is viewed as a sub-culture within a wider culture of society. It has specific organisation of system of values, status relationships and rewards through which it accomplishes its goals. It demands of the individuals a set of *roles* to be filled. These have to be precisely ascertained. Tentatively, they are grouped as *student-role*, *scientist-role*, *technical role*, and *social relations role*. The nature of these and the values and practices of the institution represent for the student the situational "press", a thorough analysis of which is essential. Based on the prescription of *roles*, the faculty builds certain *expectancies* and accordingly adjudges the performance. Successful fulfilment of these *roles* requires certain characteristics and attitudes in the individual. Some of these are intellectual while others have to deal with interpersonal relations and the emotional and dynamic aspects. Therefore, a scientific study of factors associated with success would entail an analysis of the environmental "press" and the *roles* prescribed seen in their transactional relationships with the psychological characteristics of the individual expected to fulfil these roles. This would ultimately lead to the classification and elaboration of a personality model for the hypothetical individual capable of optimal role-fulfilment.

PERSONALITY

60. Personality composition of the Artists (Painters)—A preliminary survey.

PRYANSIHU SEKHAR BHATTACHARJEE, Calcutta.

This is an initial report of a fact finding study on personality composition of the artists, who have taken up painting as their profession.

The people who express their inner power through paintings and sketches must have certain points of differentiation from the common people. So in this present study an effort has been made to search for qualitative picture of the personality make up of the artists by the help of rating scale technique.

The behavioural qualities, i.e. the rating items are selected in collaboration with the artists of fame and repute. These trait names after proper check up and arrangement were given to other fifty artists of responsibility for rating. The twelve mental qualities in final, given in this paper are those that have come after careful examinations. The tenability of the selected traits in rating procedure will be understood after construction and selection of psychotechnical tests applicable for measuring the nominated behavioural qualities of the artists. One test battery, including psychometric and projective tests of mentality that has been suggested here, requires further investigation to use for diagnostic purpose.

61. The Normal and the Transcendental Levels of Psychological Maturity.

D. DHAIRYAM, U.S.A.

Psychological maturity is a dialectical process. The child grows in the context of an all-pervasive dependency. In adolescence, his self-assertion climaxes in questioning the intellectual and emotional ties holding him to his little familial circle. He reaches to the world outside, and after some floundering discovers a healthy relationship to it. There is the thesis of child-hood dependency, the anti-thesis of adolescent rebellion and of transitional floundering, and the synthesis of adult adjustment in society. A normal, psychologically mature person establishes self-satisfying and productive interpersonal relationships in all aspects of his life as a full member of society.

A few exceptional adults of most cultural societies go through phases of higher psychological development very similar to that of adolescents. There is the thesis of normal maturity, the anti-thesis of self-assertion against their culture and of transitional floundering, and the synthesis of a transcendental psychological maturity. At that level, they transcend the limitations of their culture, and evolve a philosophy of life embracing peoples, irrespective of cultural differences. They live an inner life whereby they mobilize and utilize their psychic resources intensively. Their social adjustment is secondary.

62. The organization of interests and personality traits among college students.

J. FILLELA Bombay.

The purpose of the present study is to investigate the relationship underlying the organization of interests and personality traits in a normal population. The scores of a group of 100 students in the Intermediate Science and Arts classes of St. Xavier's College, Bombay, on the scales of the Kuder Preference Record, Vocational Form BM, and on the scales of the Edwards Personal Preference Schedule were intercorrelated. The resulting 24×24 correlation matrix was subjected to a factor analysis.

The correlation coefficients indicated that although their size was moderate, their distribution in the matrix was such as to point to clear-cut patterns underlying the intercorrelations between interest and personality variables. First of all, it was noted that there was a higher proportion of significant correlation coefficients when the personality scales were compared with one another and when the interest scales were compared with one another, than when the personality scales were interrelated with the interest scales. The same finding was observed after factor analysis and the rotation of axes. Two orthogonal factors were identified: one bipolar personality factor with high loadings on personality scales and one bipolar interest factor with high loadings only on interest scales. Two further bipolar orthogonal factors were identified.

All factors were rather complex in nature. They were identified as follows: Factor I' was a personality factor: friendliness vs. autonomy. Factor II' was characterized by patient effort vs. tendency to look for help. Factor III' was an interest factor: scientific and practical vs. clerical and literary activities. Factor IV' was identified as social welfare vs. tendency to look for personal help.

63. Self-acceptance and Acceptance of others. A Personality study of Indian College Students of Bombay.

J. M. FUSTER, Bombay.

Do different Indian cultures motivate self towards other characteristically?

Two Hypotheses: 1. Congruence between perceived self-acceptance and ideal self-acceptance varies directly with objective acceptance of others.

2. The above relationship is a function of various psychological factors as found in Indian College student communities.

30 boys and 30 girls of each of the four communities, Hindu, Muslim, Catholic and Zoroastrian were used. Stephenson's Q-Methodology was used. Q-sorts reflecting self-acceptance, and a scale measuring the general attitude of acceptance of others were administered.

The first hypothesis was verified in Zoroastrians in an r of .40 which is significant at the 1% level, and in Hindus in an r of .29 significant at the 5% level. No significant was obtained in Catholics and Muslims.

The second hypothesis was tested by a centroid factor analysis by the Thurstone technique. Zoroastrians and Hindus are not in a bipolar relationship. The difference between Zoroastrian variance and Hindu variance was significant at the 2% level. The common factor was labelled in terms of the Q-sorts, "self-confidence to face different situations". Zoroastrians possess it in a larger amount than Hindus. The former use it for relating with people-sociability; the latter, use it for accomplishment-personality-development.

64. Study Habits in relation to Personality Factors.

B. KRISHNAN, Mysore.

Two instruments standardised by the author, one on study habits and another on Kretschmer types of cyclothymes-schizothymes were administered to a group of 161 College students, with an idea of finding out the relation between study habits and the factors of Personality, arrived at employing Q-technique, using the above questionnaire. The results have indicated that a few factors of Personality have a significant positive correlations with study habits. The results suggest that a further investigation on samples of moderate size taking from different parts of the country might throw better light on study habits in relation to personality structures.

65. Study of Personality through author's works.

K. K. PAKNIKAR, Poona.

An unexplored field of psychological study viz. Literary products of great world authors—Products of experience of communities as left behind in the form of customs, beliefs have been studied—a great author's personality through his works not studied—Here is an attempt of studying Kalidas's personality through his works—Objective of study—(1) To bring this field of study to the notice of psychologists for the following reasons (a) Great authors influence man's motives of life. Yet what specifically influences them is not sometimes recognised by man. This is an attempt to define such forces. (b) Such a study would bring great authors life's motives before educationists and philosophers of the present day. (c) Cultural contact for international understanding will be encouraged. Basis of Study—Works of Kalidas—Frequencies of expressions of thoughts and feelings taken to hint at motives of author's life—Strongest motives express themselves so often in behaviour—an accepted law of human behaviour—Some types of expressions selected (1) expressions directly touching high motives of life e.g. expressions about reputation—high frequency—, therefore, a motive of his life, (2) expressions giving sentiments about mother or persons revered, (3) expressions hinting at probable experience of poet's life-note regarding reliability of such study.

66. Alcoholism and personality adjustment.

M. N. PALSANE, Baroda.

The present study is an inquiry into the adjustment or maladjustment of the alcoholic personalities. The inquiry is confined to the lower class alcoholics only. The alcoholics are divided into three groups A, B and C according to the degree of addiction. Those belonging to A group drink daily, those belonging to B drink

regularly once or twice a week and those from C group drink occasionally two or three times at the most in a month. The adjustment of these people was assessed by a modified form of the well-known Bell's Adjustment Inventory. And comparisons were made among the three groups as regards their mean total adjustment and also as regards home, health, social, emotional and occupational adjustments. On the whole the degree of addiction showed close correspondence with the degree of maladjustment. The daily drinkers (Group A) were found to be significantly more maladjusted than those who did not drink daily (Group B and C). This was the case with total adjustment as well as home, health and emotional adjustment.

67. Modification of Opinions of College Students under Prestige Effect of Propaganda.

A. S. PATIL, Baroda.

In an earlier study, the author observed sex differences in suggestibility, among high school pupils, disappearing with advancing training. The present study has been undertaken to check this suggested relationship, at a still higher college level of education. More specifically, the aim of the study has been to investigate among college students the prestige effect of propaganda labels, as related to (i) sex differences, (ii) level of training and (iii) course of education. For this purpose, data were provided by M. S. University students of Baroda, distributed thus : 20 men and 20 women students from each of the two classes, viz. preparatory first year and graduating final year, in each of seven Faculties, viz. Arts, Social Sciences, Physical Sciences, Home Science, Engineering, Medicine and Education, giving a total of 560 subjects. The study of the main effects as well as interactions of these three variables was possible through the use of a factorial experimental design $2 \times 2 \times 7$ giving 28 subgroups.

The task technique together the data was the use of a multiple issue attitude scale (MIAS) in two forms specially devised by the author. The first form of the scale contained 18 different statements on current controversial issues and the subjects were asked to give their own opinion on each on a five point scale. The second form of the scale consisted of the same content in a reversed form to conceal the apparent identity, but this time each statement was followed by the name of an eminent leader. The second scale was administered after about a week to the same students and the deviations in the opinions as a result of the prestige labels were calculated. These deviation scores which formed a good measure of suggestibility were analysed and the analysis warranted the following conclusions :

1. The propaganda labels exerted a substantial influence on all subjects in changing their opinions, the direction of change being mostly unrelated to type of prestige. However, the nature of the statements and the type of the prestige of the author had, no doubt, in some cases a differential influence on the subjects in changing their opinions.

2. However, the effect was far from complete; some yielded, a few resisted, depending on other psychological factors.

3. At college level, girls were found less suggestible than boys.

4. Suggestibility was an inverse function of training; preparatory class students were more amenable to suggestion than the graduating class.

5. Type of training or the course of education was also a determining factor of influence; on the whole student-teachers under training were most affected and medical students the least; however, higher order interactions complicated some results.

68. Subjective factors in judging personality traits.

R. RATH, Cuttack.

112 college students belonging to eight tutorial groups were taken as subjects for this investigation. The average period of acquaintance of the different groups varied from 4-7 years to 1 year. All the subjects were asked to judge the traits of intelligence and neuroticism of their group mates. All the scores were graded and the average group rank of each individual in relation to the group was calculated. The subjects were asked to arrange their group mates in order of preference. The average group preference rank of the subjects was determined. All the subjects were also given the tests of intelligence and neuroticism which had been standardised on a similar college population.

All the groups excepting one were not able to judge correctly the traits of intelligence and neuroticism of their friends. But all the eight intercorrelations between estimated neuroticism beginning from normality to higher neuroticism and preference were significant at one per cent level. 7 out of 8 correlations between estimated intelligence and preference were significant at one per cent level and one at 5 per cent level. There was also positive and significant relationship between estimated intelligence and estimated neuroticism. 3 out of 8 such correlations were significant at one per cent level and five at 5 per cent level.

In short it was indicated that the college students judged intelligence and neuroticism of their friends with a common and consistent bias. Those who were preferred as friends were attributed greater intelligence and less of neuroticism and those who were not preferred were considered dull and neurotic. This general and consistent trend in all the eight groups was rather very remarkable.

69. Typological Relationship between Various Personality Assessments.

K. RAY-CHOWDHURY, Aligarh.

The present paper reports an investigation sponsored by the author and carried out in 1958-59 under the author's supervision and active participation by four post-graduate researchers, namely Quazi G. Alam, Arun K. Ganguly, Bashir Ahmad, and Habibur Chighani. The personality assessments were made with the help of the following tests: Allport-Vernon Study of Values (modified by the author in Indian situation, cf. *Ind. Psychol. Bull.*, Vol. III, Part II), Maslow's Security-Insecurity, Eysenck's Social Attitude, Allport's Ascendancy-Submission Scale. The tests were administered on a sample of 235 students of Aligarh University. The students' achievement level was matched to M.A. (Previous) standard by equating their years of training in the University after their having passed the Intermediate Certificate (i.e. I.A., or I.Sc., etc.) Examination. Hence, it was possible to obtain a random sample of 235 students belonging to various courses which were grouped under relevant categories, such as Humanities (N=30), Natural Science (N=30), Physical Science (N=30), Legal Studies (N=30), Business (N=30), Engineering (N=30), and Library Science (N=25).

The test scores were first normalised, and then the enquiries of the relationship between high and low scores (*as a criterion of types*) on the above tests were carried out with the help of 't' technique. High and low scores were 17½% top and 17½% bottom cases. The enquiries have yielded very interesting results of the relationships between the personality assessments.

70. Analysis of the Fantasies of Children.

MRS. MANJULA S. WARTY, Baroda.

The purpose of the investigation is to have a closer contact with the child's fantasy life, with a view to analyse it, assuming that some of their problems, needs and attitudes may find expression through their fantasies.

The method used is a projective (picture) test. A set of six pictures selected from Miss Lydia Jackson's "Family Attitude Test" was made use of. All the pictures signified situations, likely to happen in the family life of the child.

Hundred children from four different schools in Baroda between the age 8 to 10 years were given the test and were asked to formulate stories around them. Their response were taken down verbatim.

The data was analysed and classified, collectively, both by cases and by occurrences, on the basis of "emotions". The same analysis was carried further for each picture separately. Next it was analysed on the basis of "environmental categories."

The analysis leads to many important conclusions regarding several problems of children. The fantasies directly point to some of the topics constituting children's worries and anxieties. Financial insecurity, parental rejection, parental responsibilities, punishment and possibility of accidents or illness are seen to be the main problems of the child's anxiety.

Some of their prominent needs as need for acceptance and attention or need for a moral pattern etc. are discussed, along with the significance of their attitude towards themselves, their parents, school teacher and playmates. From these discussions the helpless and dependent nature of childhood is seen together with the way in which children take their problems and face the situations.

PSYCHOMETRY

70A. Attitude towards Reception of Technology.

VIDYA JOSHI, Lucknow.

Attitudes as a function of personality structure are determined by social organization, technology and system of values. The technological system represents on the one hand organization of the economy of the group and on the other it reflects the ideal of life implicit in its culture. The latter for the most part is translated into the value system that operates in the group. The receptivity to changed modes of technology would depend on these values as well as on the material resources and talents and skills available in that society.

The paper advances the hypothesis that adoption of new techniques would ultimately depend upon the values rather than upon material resources and latent skills, available in the given society.

Using the questionnaire method the present investigation explores the problem of the relative receptivity of changing technologies by taking samples from—Rural, partially industrialized and highly industrialized areas.

The analysis of data reveal distinct patterns of responses given by the three samples.

In interpreting the findings the paper critically examines Psycho-Analytically oriented (Freud-Ransie) and cultural interpretation of resistance to change. An explanation of the phenomena in terms of communication blocks and the rigidity of value system. Value system is a organization of stable preferences, choices and action patterns. This is upset when new action orientations are demanded. The

result is either a flight from reality or an attitude of aggressive negativism. This leads to conscious rejection of improved techniques and to a reversal to crude traditional modes of living.

71. Construction of an attitude scale by the method of paired comparisons.

TAPEN BANERJEE, Calcutta.

To assess the attitude of Bengalees towards interstate marriage eight states, S. I., Bombay, Punjab, U. P., M. P., Orissa, Assam and Bihar, have been selected, and arranged in twenty eight pairs. The opinions of 500 cultured Bengalees have been taken, by supplying each of them the form containing the 28 pairs of States and asking him to select one state from each pair, with whom he prefers to come in matrimonial connection. As the scaling of this attitude is based on the method of paired comparisons, the proportions of judgment each state received as compared with every other have been calculated from the preferences of these 500 people. The proportions are then arranged in a table. This table is the proportion matrix. The proportions are then translated into normal deviates, from which a Z-matrix is obtained. From the Z-matrix seven estimates of the scale values for each state are found. The means of these estimates for each state are then calculated. Each mean is multiplied by $\sqrt{2}$. The scale values are then calculated by assigning a value .000 to the smallest scale value by adding successive means to obtain the final scale values for all the states.

The preferential selection of states with their respective scale values is given below :—

1. Bombay	...	...	1.057	5. Assam	...	...	.599
2. Punjab	...	...	.919	6. M.P.	...	...	.288
3. U.P.	...	...	.892	7. Orissa	...	...	.130
4. S.I.	...	...	.783	8. Bihar	...	...	.000

72. Construction of a table for estimation of item validity indices in terms of Davis Discrimination for Criterion groups based on Median Split.

S. CHATTERJEE and MANJULA MUKHERJEE, Calcutta.

Davis Discrimination index which is the most desirable statistics for item analysis purposes cannot be used with small groups, as it makes use of the 27% tails of the distribution alone. Attempt was made to construct a chart for estimating the aforesaid index when the groups are split at the median of the score distribution. Method used for constructing the chart and the rationale behind it is discussed in detail, with the presentation of the chart.

73. Validity Study of a College Aptitude Test Battery.

S. CHATTERJI and MANJULA MUKHERJEE, Calcutta.

This paper is the second report on the development of a Differential Aptitude Test battery for differentiating those who are suitable for the Science course from those who are suitable for the Arts course. The validity study of the aforesaid battery is presented in this part. In addition to estimating the correlations between the criterion and test scores, the correlations were corrected for restriction of range. Moreover a weighting system for the tests used in the battery is developed for maximizing the validity. Suggestions for further improvements in the battery is also presented.

74. A Study of the Validity of a Symbol Test for differentiation of normals and abnormals.

BIMALKESWAR DE, Muzaffarpur.

The Aims of the Study :—

The present study was undertaken with a view to exploring the possibility of differentiating the normals and abnormals on the basis of their verbal responses made to twelve sex symbols. These symbols were selected from Kate Franck's Study entitled : Preference for Sex Symbols and Their Personality Correlates, reported in Genetic Psychology Monographs, 1946.

Six of the symbols represented male sex and the other six, female sex. All the symbols were "matched as closely as possible for degrees of darkness, brightness, area covered, techniques employed and for general aesthetic value."

In addition to the major aim, there was also a subsidiary aim. It was subsequently thought that if the psychoanalytic theory about the importance of the sex role in personality disorganisation had any validity, then the responses made to these symbols by normal and abnormal subjects would show characteristic diagnostic differences.

Samples Used :—

A total of 187 subjects constituting three samples,—a normal, a neurotic and a psychotic, were tested. All the subjects were males.

<i>Sample</i>	<i>Number</i>	<i>Kinds</i>	<i>Av. age.</i>
Normal	55	Soldiers & Students	21.9
Neurotic	70	Dysthymics	38.8
Psychotic	62	Schizophrenics	32.2

All the subjects belonging to the two abnormal groups were cases of functional disorders.

Procedure :—

The test was administered in the same manner as a Word Association Test is administered. The only difference was that here a set of symbols were used for stimuli instead of words. The symbols were presented visually by means of a simple tachistoscope.

Scoring System :—

Four different techniques were used :

- (1) Response time, recorded with a stopwatch, was a scoring category;
- (2) The responses given by all the subjects to each of the symbols were grouped together sample-wise under the category of response fluency;
- (3) All the responses given to each symbol by all the subjects were grouped together symbol-wise and coded as normal, neurotic and psychotic, as the case may be;
- (4) The responses to each symbol were separately rated on a concrete-abstract continuum scale.

Results :—

The scored data were treated statistically by Chi Square, Analysis of Variance and t tests of significance. Among the scoring categories, only one, namely, long response time was found to be diagnostically significant. The other categories failed to differentiate significantly the groups.

The other purpose of the study was to examine the validity of the Freudian theory regarding the active role of sex in personality disorganisation. But the evidence collected by this study raised grave doubts about the validity of the Psychoanalytic theory.

75. A Scale Procedure for Scholastic Achievement Tests.

A. K. GAYAN and R. K. MATHUR, Kharagpur.

A simpler method using Cornish-Fisher-Technique for Normalisation of variables is indicated for working out equivalent scores. The method takes into account the differences in the distribution of scores in the different achievement tests. It appears to give equivalent scores that are in remarkable agreement with values obtained otherwise by available methods, involving heavy computations.

76. Nature of Discriminal Dispersion.

RANJIT KUMAR MAJUMDAR, Calcutta.

The objective of this paper is to present a picture of the psychophysical data emphasising the probability question, specially (it aims to study an aspect of the law of discriminial process i.e.) if the discriminial process of a response conform a normal probability curve.

In the experimental procedure the stimulus was visual angular extents e.g. 51°, 53°, 55°, 61°, 63°, 65°, 71°, 73°, 75°. Subjects were 20 in number. 400 responses against each stimulus angle were obtained. Moments, cumulants, g_1 & g_2 and Var g_1 , Var g_2 were calculated.

From skewness point 7 stimuli (55°, 61°, 63°, 65°, 71°, 73°, 75°) are unbiased (error not beyond 5% level) and from kurtosis point only 3 (63°, 65°, 71°) are unbiased (error not beyond 5% level). Taking both aspects only 3 (63°, 65°, 71°) are in good compatibility of the normal shape.

77. Construction of a Psychological Scale of Length and Deduction of Formulas for it.

AMAL KUMAR MALLIK, Calcutta.

An experiment on subjective length was conducted by the author with the intention of constructing a psychological scale of length. For this purpose the fractionation method was used. Standard lengths of 50, 100, 150, 200 and 250 mm were tested, and six comparison lengths for each of these standard lengths were taken. The comparison lengths were presented (i) horizontally and (ii) vertically along with the corresponding standard lengths, which were invariably presented horizontally. Twenty-five observers gave their judgment.

No significant difference is found between the observers' judgment for (i) horizontal and (ii) vertical presentation of comparison lengths. From the observers' judgments 51.4 mm. is found to be judged half as long as the length of 100 mm. This subjective length of 51.4 mm. corresponding to a physical length of 100 mm. is taken as the unit, and is termed 1 Länge. Similarly the subjective length corresponding to the physical length of 51.4 mm. is regarded as half Länge. Thus a scale of subjective lengths has been constructed. The functional relation between the physical and psychological scales has been determined both graphically and analytically. Some empirical equations relating the physical length in mm. to the psychological length in Länge has also been deduced.

78. The extreme groups in item—analysis.

R. K. MATHUR, Kharagpur.

In item-analysis procedures it is customary to carry out analysis based on two extreme groups only, dropping out those in the middle. Taking groups from the extremes sharpens the differences observed in a single item. However, this increasing sharpness of discrimination is more or less balanced by the instability of discrimination which results from including only the extreme groups of small sizes. So the problem is to find out an optimum point at which the balance between sharpness of discrimination and the stability in the resulting values is obtained. Kelly (1939) showed that the ratio of the obtained differences to its standard error is a maximum when the top groups and the bottom groups each includes approximately 27 p.c. of the total group. This 27 p.c. rule, however, holds for strictly normal distribution of Criterion Scores. The present paper investigates what should be the comparable rule for inordinately Non-normal distribution of criterion scores, a situation more frequent than one of perfect Normal distribution. Criterion scores have been assumed to be distributed in Edgeworth's form of type A populations. Table of extreme group-sizes for various values of indices of Skewness and Peakedness have been worked out.

79. Validity of medical student selection tests.

SHIB K. MITRA, Calcutta.

The productive validity of a battery of nine tests used in the selection of students in a medical college has been examined. The criterion was an average of marks in college examinations. Multiple regression and centroid factor analysis methods were used.

80. Comparative Study of Revised Goodenough Draw-a-Man Scale (Harris) and Phatak's Draw-a-man Scale for Indian Children.

PRAMILA PHATAK, Baroda.

Goodenough's Draw-a-man Scale has attracted a number of psychologists and educationists in India. Some four years back the author has developed a new scoring scale which has been found more appropriate to Indian situation. In the University of Minnesota Dr. Harris (now at Pennsylvania University) was Revising Goodenough Scoring Scale.

This paper analyses the scoring of 300 American children of the age groups five years to ten years (fifty at each level) on the unpublished Revised Goodenough Scale and the scale developed by the author of this paper.

The coefficient of correlation between the scorings on the two scales is 0.87 PE: .0265.

Age-wise means and standard deviations are calculated and tested for significant differences at successive age groups. Revised Goodenough Scale (Harris) shows one C.R. between nine years and ten years significant beyond doubts while the remaining four are significant but less than 3. The scale developed by the author shows three C.R.s which are significant beyond doubt. The remaining two, between seven years and eight years, and eight years and nine years, are significant but less than 3.

As the comparative study is not yet complete tentative conclusions are drawn.

The author is grateful to Dr. Dale B. Harris for giving her an opportunity to work with him in the University of Minnesota and allowing a free use of his collections of human figures drawn by American children.

81. Table and abac based on Gaussian Curve Model for Null-Hypothesis Testing in a Binomial Distribution.

A. V. SHANMUGAM, Mysore.

A table and an abac based on Gaussian Curve model are prepared, and presented for the use of Research workers in the field of Psychology and allied branches of knowledge so that one can read with the least effort the minimum frequency required, for different sizes of samples, in the area of investigation to reject the null-hypothesis, at .001, .005, .01, .02, .05, and .10 levels, formulated on a sample of frequencies of binomial type.

SECTION OF ENGINEERING & METALLURGY

President :—PROF. N. N. SEN, M.Sc., A.R.S.M., F.R.I.C., M.I.E.

Abstracts

1. On analysis of Beam and Slab floors.

K. K. BANERJEE and M. M. BASOLE,

Analysis for Built-up Slabs presented in an earlier paper is extended to obtain distribution characteristics for beam and slab type floor system for concentrated loads.

In a built-up slab longitudinal joints between the precast units act as hinges and the units themselves are taken as rigid bodies in so far as transverse bending is concerned. The solution results in sharp changes of slope at the joints. The present attempt is to restore continuity of slope by the provision of joint moments in the transverse direction. A set of simultaneous equations are formed on the basis of compatible joint slopes and the solution provides the relation between the joint moments and the joint reactions.

Since in this case the slab is flexible the deflection of the edge of a unit due to joint reaction is considered. Similarly, the contribution of joint moments to the deflection of edges are also taken into account. These two conditions alter the equations for deflection previously obtained.

The direction of moment required for the continuity is obtained from a prior knowledge of deflection profile, but the difference in moments at the two edges being small is not considered to cause any twist to the unit.

The distribution characteristic for deflection obtained theoretically compare favourably with the observed values, obtained through experiment conducted on a model.

2. Possibilities of the Activities of a Hydrological Organisation.

A. P. BHATTACHARYA, Roorkee.

The need of a full-fledged hydrological organisation has been stressed for India with her growing hydrology consciousness as also a development programme of multi-purpose river valley and minor irrigation projects involving detailed hydrological studies. Paucity of sufficient and continuous data has always been felt to be a stumbling block in such studies. Various phases of the data have been set forth. These include precipitation, runoff, floods, groundwater, infiltration, evaporation and interception, sedimentation, quality of water. Their importance and proposed methods for the initiating of the recording of systematic observational data have also been given. It is suggested that the setting up of such an organisation is sure to go a long way in the proper appraisal and utilization of potential water resources of the country whose supplies are limited.

3. Long term peak rates of flow by maximum likelihood method.

G. M. PANCHANG and V. P. AGGARWAL, Poona.

Hydrologists have availed Fisher and Tippet's Extreme Value Theory for estimating the 50-year, 100-year, etc. return periods' expected maximum flow rates in rivers from the maximum flow rates observed annually over a limited number of years. The two constants in the probability expression

$$P(x) = a.e^{-a(x-u)} e^{-e^{-a(x-u)}}$$

for the tail distribution were evaluated by equating the first two moments or their like. Alternatively, the expression is given a linear form

$$x - u = (1/a) \log \log T / (T - 1) \quad (2)$$

and some approximate procedures of measuring the return periods (T) of the observed flow rates have been postulated. The T measures and the corresponding flow rates are then availed for estimating the two constants by the method of least squares.

A procedure aiming to obtain better efficient estimates has been employed in the paper. Thus, the two constants in (1) are now estimated by maximising the probability of the joint occurrence of the n years observed annual maximum flow rates. The maximum likelihood estimates so arrived later of the expected peak rates of desired long term return periods are found better precise than others. The estimation procedure is also seen to be relatively less inert to one or two missing values including the highest observed.

4. Some relay-operated flip-flop circuits—I.

R. PARSHAD and T. SINGH, New Delhi.

Four new circuits of relay flip-flop have been devised. The circuits use single coil relays with the simple normal-make, normal-break or break-before-make contacts.

Working details of these circuits are described. The circuits are simple to adjust and are stable in operation.

5. Some relay-operated flip-flop circuits—II.

R. PARSHAD and T. SINGH, New Delhi.

Three new circuits of relay flip-flop have been devised. The circuits use single coil relays and simple relay contacts.

6 A multipurpose meter using bridge rectifier.

D. P. CHAKRABARTY, Agra.

This paper describes the design and construction of a multipurpose instrument for the measurement of current, voltage, power and power factor by utilizing a bridge-rectifier circuit along with the vacuum tube metering arrangement. Current or voltage measurement is simpler and can be measured by different means. Particularly the measurement of power and powerfactor by this method has advan-

tages over other types that it does not introduce too much error due to frequency and waveforms. The meter can function at higher frequencies also. The measurement of phase angles near to 90° by means of metal rectifier as half or full wave was shown by Prof. G. H. Rawcliffe and C. M. Brownsey (Ref :—J.I.E.E., Vol. 95, Pt. II No. 44, April, 1948). Here also the rectifiers are used to measure phase angles, but in a different manner. The instrument as a power measuring device may be made extremely sensitive and it can be used for measuring very low power by using step-up current transformer in the load circuit.

7. Effect of waveform on relay testing.

R. N. GANGULY, Calcutta.

It is important that the waveform of test current should be as nearly sinusoidal as possible particularly for the tests of high impedance relays. Current operated induction relays are purposely designed with a limited magnetic system in order to produce an inverse time characteristic and thus the core becomes saturated even with moderate overcurrent. The outstanding feature of the above is that the waveform is more peaked than the sinwave and usually contains a prominent third harmonic. A reduction of torque may be produced by a shifting of the fundamental and harmonics of current in the disc with respect to the corresponding components of flux. The usual effect of distorted waveform is therefore to slow the operation of relay if the waveform is not sinusoidal. Thus the actual operating time under condition of fault will be shorter than that indicated by test.

Electric power system in our country have grown to such an extent that in order to maintain satisfactory discrimination all relays must be fundamentally accurate.

In this paper, the author discusses the results of experiments carried out with distorted current waveform. These results are carefully interpreted in the paper with a view to presenting satisfactory solution to this problem.

8. Electronic Instruments in Gas Turbine Research.

D. BANERJEE and S. C. MUKHERJEE, Howrah.

The paper deals with the development of some new Electronic Instruments for measuring temperature, speed of rotation and torque in connection with the Research Programme on Gas Turbine Development at the Bengal Engineering College. In this paper a brief summary of other forms of available instruments have also been outlined and their comparative utility analysed with those of the instruments developed under the programme. For measurement of R.P.M. and torque pulse technique has been used whereas a selective amplifier has been used for temperature measurement. The work done so far has been restricted to a laboratory scale although the commercial aspects of these instruments have been given due consideration.

9. Magnetic measurements at Power, Audio and Radio frequencies : (A resume of recent methods).

J. K. CHOUDHURY, Calcutta.

Magnetic measurements with alternating inductions in the core include the measurements of the core-loss and the a.c. permeability. While wattmeters may be

used for the determination of the core-loss, a.c. bridge methods are suitable for the measurements of both the core-loss and the permeability.

The non-linearity in the relation between B and H in a magnetic core and the extremely low power-factor of the magnetic sample at high inductions in the core introduce the chief complications in magnetic measurements. Modern low-loss alloys and powder cores present highly complicated measurement problems.

Wattmeters with proper connections may be made to indicate the true power absorbed by the core. But, in measurements with the a.c. bridges,—which are extensively used at high audio frequencies and radio frequencies,—balance is obtained only for the fundamental component of voltage; the true core loss has to be computed after suitable corrections for the harmonic losses in the components associated with the magnetic core. Due to the non-linear B - H relations, even with sinusoidal inductions in the core, the magnetic core acts as a harmonic generator. The true core-loss at fundamental plus harmonic frequencies can be determined from the bridge balance conditions at fundamental frequency only after proper corrections have been applied for the harmonic ohmic loss in the external circuit of the magnetic core. A core supplied with sinusoidal flux absorbs power at fundamental frequency from the supply source, part of which it absorbs as fundamental frequency core-loss, part as harmonic frequency core-loss and the rest is dissipated as harmonic ohmic loss in the external series circuit.

The paper reviews the various methods used at present in the light of the above noted peculiarities and complications of the magnetic core as a circuit element; special emphasis in the discussions have been given on the suitability of two recently published techniques, e.g. the Electrostatic Wattmeter and the Bridged-T Network in their respective fields of measurements.

10. Analysis of a Particular Servo-system.

II. B. MOHANTI, Kharagpur.

A servo-system with two nonlinearities such as Backlash and Deadspace in series is considered. With these nonlinearities the physical behaviours of the second-order and the third-order servo-systems have been studied. Special attention has been given to the analysis by analogue computer. Theoretical analysis by non-linear transfer function is put forward to predict the condition of stability and this has been verified by the analogue computer. Optimum design criterion is employed on these non-linear systems to obtain the optimum values of the parameters involved for the best performance and this has been achieved by analogue computer.

11. The Dielectric Properties of Copal Ester.

G. N. BHATTACHARYA and A. K. SEN, Calcutta.

The dielectric properties of copal ester have been measured over a wide range of temperature and frequency viz., from 25°C to 160°C and from 400 c/s to 300 kc/s. The dielectric loss-temperature and permittivity-temperature curves exhibit the typical characteristics of a polar liquid in the anomalous dispersion range. The power factor as well as the loss curves begin to rise from about 50°C . The loss maxima for 1 kc/s, 10 kc/s, 50 kc/s, 100 kc/s and 300 kc/s are more or less of the same value while for 400 c/s it is slightly higher. The range of temperature over which these peaks are distributed is about 42°C . The striking feature of these loss curves is their unusually broad peaks. The dielectric constant curves

are also flat. The nature of all these curves indicates the effects of distributed relaxation time in the copal ester molecule in a greater degree.

The application of Debye's equation for obtaining the size of the rotating unit has revealed an interesting fact. The obtained size of 1.5 \AA is much less than the actual size of the resin molecule, which therefore can not be ascribed as its rotor. But the value of the rotor size so obtained exactly coincides with the effective radius of the hydroxyl group. In fact the presence of hydroxyl groups in this resin has been actually confirmed from its infrared absorption spectra by the presence of the characteristic absorption peak of hydroxyl groups at 2.72μ . This fact tends to suggest that as in ester gum, which is a similar glycerol ester of rosin, the hydroxyl groups—and not the large molecules of copal esters are probably the actual rotating units of this resin in the electric field.

12. A comparative study of the performance of a harmonic generator with sine wave drive and rectangular pulse drive.

K. S. PATEL and B. M. BANERJEE, Calcutta.

The performance of a Class C Harmonic generator with respect to sine wave drive is limited at most to the fourth or fifth order harmonics. Higher order harmonics require a correspondingly small angle of flow and the driving power increases very rapidly as it becomes smaller. Rectangular pulse drive, as can be conveniently supplied by a blocking oscillator, does not suffer from this disadvantage. Theoretical calculations have been presented for both types of drive. The peak current flow in the tube has been assumed one ampere, and the amplitudes of all harmonics up to the sixth, together with the d.c. component have been tabulated for different fractional periods (d/T) of flow. For rectangular pulse, the drive voltage is a little greater than the grid base and positive swing. The sine wave drive voltages, for different (d/T) ratios, for the tube type QQE 06/40, is given for comparison.

13. The effect of rapid fading on the measurement of the angle of arrival of the downcoming radio waves from the ionosphere.

S. S. BANERJEE and P. K. MUKHERJEE, Banaras.

The phase difference method of determining the angle of arrival of downcoming radio waves involves the measurement of the phase lag between the waves arriving at two similar parallel horizontal dipole aerials separated by a known distance, situated at equal heights above the ground. The signals from the two aerials are fed to two separate superheterodyne receivers with a common oscillator, having similar characteristics in respect of amplification and phase rotation. The output from the two receivers are then fed to the opposite pairs of deflecting plates of a cathode ray oscillograph, on the screen of which phase ellipses are obtained due to the phase difference existing between the e.m.f.'s developed due to the signals at the two aerials. If the inputs to the C.R.O. be of the same amplitude the major axis of the resulting ellipse will be inclined at 45° to the horizontal. The phase difference between the two signals is calculated from such ellipses from which the angle of arrival is determined.

In order to satisfy the above condition the two aerials should be kept at close vicinity. But to avoid the interaction between the aerials they cannot be kept below a limiting distance between them. Further, as the sensitivity of the above method is directly proportional to the aerial spacing it would be desirable to keep the distance between the aerials large. During rapid fading, however, even when

the spacing is kept of the order of one wavelength, the aerials will be in non-homogeneous field at any particular instant and the outputs from the receivers will possess unequal amplitudes. Consequently the major axis of the ellipses will not be inclined at 45° . A method has been suggested therefore for determining the correct phase difference even when the major axis of the ellipse is not inclined at 45° . It has been shown that the correct phase differences may be obtained either by the intercepts of the ellipses on the 45° radials from the origin or the perpendicular distance between the tangents to these ellipses which are parallel to the 45° radials. The method has been experimentally verified and correct angle of arrival has been determined.

14. Three phase electronic oscillator for the power supply at low and high frequencies.

S. S. BANERJEE and A. B. BHATTACHARYA, Banaras.

An electronic wattmeter designed for the measurement of low and high power was used for the measurement of power consumed in a balanced load circuit at power frequency connected to the three phase power supply system. The effect of the asymmetry in such a system was discussed in one of our previous papers (Proc. Ind. Sci. Cong. Part III Abs. 1959 p. 553-554). In order to study the performance of such a wattmeter at higher frequencies a three phase supply at such frequencies is necessary. An electronic three phase oscillator was therefore designed for the above purpose, the details of which are communicated in the present paper.

The electronic oscillator designed essentially consists of (i) Three identical amplifier system (ii) A frequency determining and phase shifting network, and (iii) An amplitude limiting and phase shifting device. The phase shifting device consisted of the conventional single mesh R-C network. It can be shown that such oscillators inherently generate oscillations at two frequencies, one at high and the other at the low or audio frequency regions. As a matter of fact, oscillations at both the frequencies are maintained simultaneously as the minimum gain required for maintenance of the two oscillations is the same. It is, therefore, necessary to suppress one of the oscillations for proper functioning of the system. A comparative study of the various methods available for suppressing the R. F. mode of oscillations shows that they are not always suitable in practice as either asymmetry is produced in the different phases of the output or the load circuit of each of the amplifiers has to be changed suitably. Therefore, the present method has been adopted in which a frequency sensitive feedback loop is introduced in each stage of the oscillator. At high or radio frequency the circuit connections are such that the feedback is sufficiently negative to reduce the gain of the R. F. mode below the value required to sustain the oscillations, and at low or A. F. mode of oscillations, the feedback loop is so designed that it introduces a phase shift to develop sufficient positive feedback and thus audio oscillations are maintained with considerable amplitude. Pure waveform may be obtained by maintaining the symmetry of the three identical stages and selecting the load for operating the valves just above the critical gain condition.

15. Crosstalk in T.D.M. Systems for Cables and Lines.

J. DAS, Kharagpur.

Performances of Time-division multiplex systems on cables and lines have become of recent interest due to the requirements of telemetering, data transmission

and electronic exchanges. Crosstalk characteristics of P.A.M., P.S.M., P.L.M. and P.P.M. have been analysed here with special reference to their application on lines. It has been shown that for practical values of channel separation, P.P.M. gives the best crosstalk attenuation and P.S.M. has a crosstalk attenuation better than that of P.L.M. or P.A.M. For large values of channel separation, P.P.M.—C.T. ratios vary as $t^{3/2}$, whereas the C.T. ratios in all other systems vary as $t^{3/4}$. But in P.S.M., due to the simultaneous modulation of the height and the width of the received differentiated pulses, the C.T. ratios tend to be very large as the channel separation increases. Due to the possibilities of interference from echoes on lines, the system to be used has also to be less susceptible to this type of impulse noise.

16. Horizontal Polar Diagrams of a Microwave Paraboloidal Reflector in the Fresnel and Quasi-Fraunhofer Regions.

S. S. BANERJEE, K. K. DEY and A. P. KULSHRESTHA, Varanasi.

The observations for polar diagram of a microwave paraboloidal reflector is usually taken in the Fraunhofer region as the power received in that region is independent of the distance from the exciting feeder or the pick-up receiver. For an average test-site, however, it is not always possible to take observations in the Fraunhofer region which starts from a fairly long-distance from the aerial system. It has been, therefore, found necessary to investigate the difference in the polar diagrams of such aerial system in the different regions around the paraboloid. The horizontal polar diagrams have, therefore, been drawn for a microwave paraboloidal reflector fed with a single half-wave folded dipole in the Fresnel and quasi-Fraunhofer regions.

These polar diagrams were compared with the theoretical polar diagrams which can be obtained in the Fraunhofer region for the same aerial system. It has been shown that contrary to the common assumption, the lower limit of the region in which the polar diagrams show striking similarity to that in the Fraunhofer region extends to a much lower limit than that of the quasi-Fraunhofer region.

It has been thus concluded that in an average test-site the polar diagrams may be drawn for the true representation of the radiation patterns well within the Fresnel's region.

It is incidentally shown that such a paraboloidal reflector with the Yagi-array feed gives a much higher gain in the polar diagrams obtained with a folded dipole feeder, without increasing the half-power beam-width angle of the polar diagrams.

17. Metallurgy of Process of Dressing and Sulphur Treatment of Lead Bullion.

S. SARKAR, Tundoo.

The major portion of the dross consists of the entangled bullion. Experiments have been carried out with encouraging results at the Tundoo Smelter of Messrs. Metal Corporation of India Ltd. From the results obtained, it seems that the addition of Rosin in dressing operation yields better metallurgical operative efficiency but taking into overall consideration of both metallurgical and economical efficiency, the use of return Blast Furnace granulated slag will be advisable.

18. A new method for the production of nodular iron.

A. K. SEAL, Howrah.

In the present method an attempt has been made to produce nodular iron from Indian pig iron using $MgCl_2$ and/or $NaCl$ mixed with suitable amounts of Calcium-Silicide as a reducing agent. Microscopic examinations have shown that a certain amount of nodulisation is possible with either $MgCl_2$ or $NaCl$ but a better result is obtained by using a mixture of $MgCl_2$ and $NaCl$ in suitable proportions.

The important advantages of this method are :

- (i) No explosion hazards,
- (ii) Indigenous materials can be used, and
- (iii) Less costly.

19. Some aspects of martensitic transformation in copper-aluminium alloys.

RAJENDRA KUMAR and V. BALASUBRAMANIAN, Banaras.

The salient features of martensitic transformation observed in the present investigation on copper-aluminium alloys containing respectively 14.00 and 14.50% aluminium are :

- (a) The transformation progresses (i) by nucleation at new sites and (ii) by simultaneous slow isothermal growth of existing martensite plates. Slow isothermal growth of martensite has also been previously observed by other workers.
- (b) Martensite plates nucleate preferentially at pin holes.
- (c) Some of the martensite plates pass right through other plates lying in their path.
- (d) Martensite plates cross grain boundaries without any change in direction of growth.
- (e) An irregular network of markings appears after the onset of martensitic transformation. These markings were less prominent in the case of the 14.50% alloy.

20. Problems encountered in hydrogen distillation process for the production of heavy water.

DREPAK GUPTA, Bombay.

A 14 ton per year heavy water plant is under construction at Naugal, as a part of the multipurpose fertilizer-cum-heavy water project. The plant uses the hydrogen distillation process for the production of heavy water. Although it was realised as early as in 1942 that distillation of hydrogen was one of most attractive processes for the industrial scale production of heavy water, it took nearly 10 years to solve the peculiar and unusual problems associated with the handling of bulk hydrogen at extremely low temperature, before the process could be transferred from a bench scale apparatus to an industrial plant.

The present article summarises some of the major problems encountered in a typical hydrogen distillation process. Methods used to solve the problems and tests carried out to select suitable materials and equipment for the process are discussed and conclusions based on results of these tests are presented.

21. Mechanism of Corrosion Inhibitive Action of Pigments.

A. K. CHAUDHURY and S. C. SHOME, Calcutta.

The inhibitive action of red lead and litharge pigments and paints (pigment + linseed oil) against the corrosion of steel has been studied. In the investigation on the corrosion of steel in de-aerated aqueous extracts of the above mentioned paints and pigments, it is found that, in general, the corrosion of steel is reduced in the absence of oxygen. Litharge pigment and paint, and red lead paint have shown remarkable inhibition. The potential/time curves obtained in those cases indicate that the corrosion is under cathodic control. The view that only the oxidizing compounds prevent corrosion in absence of air is not found tenable in the case of litharge which represses corrosion reactions to a great extent without itself being an oxidizing agent. It appears that the corrosion inhibitive substances resulting from the degradation and hydrolysis of the red lead paint in water, can retain their protective action on steel in the absence of oxygen.

22. Development of Supersulphated Cements from Indian Blast Furnace Slag.

KISHAN LAL, S. K. CHOPRA and N. K. PATWARDHAN, Roorkee.

Supersulphated Cements are special type of Slag-Cements characterised by low-heat of hydration and resistance to the attack of sulphate and dilute acid solutions. These cements are used in mass concrete constructions, marine structures and chemical industries where general conditions do not allow the use of normal portland cement and other special cements.

The possibility of development of supersulphated cement using Indian iron blast furnace slag is being investigated. About thirty test samples of this type of cements were prepared by intimately mixing the finely ground granulated blast furnace slag (70-80%), gypsum or anhydrite (12.5-25.0%) and portland cement clinker or lime (1.5-5.0%). In view of shortage of natural anhydrite in India, artificial anhydrite was prepared by dehydrating gypsum at various temperatures and used in the mixes.

Results of investigation obtained so far show that following are the optimum compositions for attaining best strength.

	I	II
	Per cent	Per cent
Granulated Slag ...	78.3	70.0
Gypsum Anhydrite (Synthetic)	16.5	25.0
Portland Cement Clinker	5.22	5.0

28 days compressive strength of 1 : 3 cement sand mortars and concretes (mix proportion 1 : 6 cement-aggregate) was of the order of 6,000 p.s.i.

The mineralogical examination of set cements is being carried out.

23. Dephosphorisation of Alloys in Hydrogen.

B. CHATTERJEE, Howrah.

In continuation of our work on the dephosphorisation of alloys in hydrogen, studies have been made of the removal or otherwise from powdered samples (40 mesh) of three iron-phosphorus alloys, I, II, and III with 1.98, 5.18 and 9.46% P respectively on heating at 1000°C for varying periods of time in flowing

hydrogen containing 1.20 per cent by volume of moisture. The alloys have been prepared by adding powdered ferrophosphorus to molten Armco-iron. The phosphorus contents of samples II and III have been found to decrease from 5.18 to 4.43 per cent and from 9.46 to 8.66 per cent respectively in 40 hours on treatment with moist hydrogen at 1000°C while very little dephosphorisation has been found to take place in the case of sample I (P, 1.98%). These observations are in agreement with those reported previously in that these indicate that there is probably a limiting phosphorus content, below which dephosphorisation with hydrogen is rendered somewhat difficult. An examination of the micro-structures of the treated and the untreated samples also lead to the same conclusion. Further work on the dephosphorisation of alloys in hydrogen is in progress.

24. The behaviour of liquid drops falling through liquid media in the Stokesian region.

K. B. MATHUR and F. H. GARNER, Calcutta.

A study has been made of the factors which affect the critical diameter at which the transition from stagnancy to circulation occurs in a liquid drop falling through a liquid medium. The study is confined to immiscible systems and to the Stokesian region ($Re. No. < 1.0$).

The critical diameter has been found to be independent of the viscosity of the two phases and to depend upon the density difference and the interfacial characteristics of the system. For systems where the molecular properties of the components are such that a monomolecular film is formed at the interface, the critical dia. varies as the square root of interfacial tension, while for other systems it was found to vary as the square of interfacial tension. The dependence of critical dia. on the character of the surface layer is supported by experiments in which a surface active agent was added to the systems.

A new form of drop distortion where the upper surface of the drop folds inwards causing a cavity to appear at the top of the drop, has been observed for certain systems and an explanation for the caving phenomena has been proposed in terms of the hydrodynamic forces acting at the drop surface. Certain other systems were found to give the 'tailing' form of distortion which was first reported by Arnold(1). It has been found that whether drops of a certain system tail, cave or remain spherical is determined by the interfacial tension and the $Re. No.$ at which the onset of circulation occurs.

25. Studies on the design and performance of ejector as a pump in slurry reactor for Fischer-Tropsch and related synthesis.

A. K. MITRA, D. K. GUHA and A. N. ROY, Kharagpur.

The present paper describes the design and performance of an Air-Ejector employing the driving fluid as air in the pressure range of 40 lbs. to 115 lbs. per sq. inch absolute and covering a wide range of operating conditions by means of interchangeable nozzles.

The following design factors such as (1) Area Ratio, (2) Pressure Ratio, (3) Projection ratio i.e. the distance between the forcing nozzle end and the commencement of the parallel throat of the diffuser body divided by the diameter of the diffuser, (4) Mass Ratio i.e. ratio of the mass of entrained fluid to that of the

entraining fluid, were varied over a wide range to arrive at the optimum values. The dimensions of the jet pump which gave efficient performance are :—

1. Diameter of diffuser throat— D_f
2. Length of diffuser throat— $6D_f$
3. Length of diffuser outlet— $12.7D_f$
4. Length of pump from nozzle outlet— $20.7D_f$
5. Distance of nozzle outlet from diffuser throat—Variable between $\frac{1}{2}D_f$ to $3D_f$
6. Convergence angle of diffuser entrance—Well rounded
7. Divergence angle of diffuser outlet— 10°
8. Diffuser exit diameter— $3D_f$

It was found that for an optimum projection ratio of 1.9 the suction developed was maximum for all ranges of area ratios varying from 18 to 232 in five steps. In this set up an area ratio of 169 was found to give maximum mass ratio.

Extending the results obtained for Air—Air System an efficient ejector for liquid-gas system has been designed and incorporated in a Slurry Reactor for Fischer-Tropsch and Related Synthesis.

26. Zone Refining of Lead.

R. P. AGARWAL, S. V. SURYANARAYANA and H. N. DAS GUPTA, Dhanbad.

The zone-refining technique has been developed very recently. Its application for purification purpose, however, is restricted to materials (elements or compounds) in which the impurity shows appreciable difference between the liquid and solid solubilities at the point of solidification and thereby gives favourable segregation coefficient. In fact, for zone purification, the solubility of the impurity in the liquid phase should be greater than that in the solid phase and under such condition a low segregation coefficient is obtained. This latter condition is essential for the separation of one element from the other by the zone-refining technique.

It transpires from literatures that the metallurgists have been making wider applications of this technique and that this is being employed for the purification of lead also. With a view to ascertaining the conditions under which it is feasible to cause maximum segregation of silver and other impurities in the moving molten zone, sample lead bars have been subjected to this refining technique under diverse conditions of temperature and speed of zoning. The results, so far obtained, go to show that there is always impurity gradient along the bar, although the concentration of silver is greater at the end of zoning. Further work on this is in progress.

27. Problems encountered in hydrogen distillation process for the production of heavy water.

D. GUPTA, Bombay.

A 14 ton per year heavy water plant is under construction at Nangal, as a part of the multi purpose fertilizer-cum-heavy water project. The plant uses the hydrogen distillation process for the production of heavy water. Although it was realised as early as in 1942 that distillation of hydrogen was one of most attractive processes for the industrial scale production of heavy water, it took nearly 10 years to solve the peculiar and unusual problems associated with handling of bulk hydrogen at extremely low temperatures before the process could be transferred from a bench scale apparatus to an industrial plant.

The present article summarises some of the major problems encountered in a typical hydrogen distillation process. Methods used to solve the problems and tests carried out to select suitable materials and equipment for the process are discussed and conclusions based on results of these tests are given.

28. Statistical Quality Control Techniques in Textile Manufacture.

S. B. CHOUDHURI, Calcutta.

This paper deals with the successful application of the principles of Statistical Quality Control in all the different branches of Textile Industry namely (a) Batching, (b) Blowing, (c) Preparing and cutting, (d) Carding, (e) Spinning, (f) Weaving, (g) Finishing and (h) Inspection departments.

Quality control method has also been found useful in controlling unproductive time and waste percentage from machines.

29. Facilities of technical training in Independent India.

J. N. BASU, Calcutta.

Existence of the Science of Engineering and Engineering practices in India from the ancient time is evident from Asoke pillars, the Taj and many other unique structures, without evidence of any training centre. The technical training began in the year 1825 with the starting of the Industrial School in Calcutta and Bombay that turned into the Bengal Engineering College, Sibpore and the Engineering College, Poona. Subsequently came into existence the institution in Madras, Roorkey and V.J.T.I., Bombay in the 19th century. All the remaining Engineering Colleges came into being in the 20th century.

Industrialised countries of the world did not initiate technical training very much earlier, nor had they any special tradition; still they advanced much ahead of India. The colossal backwardness of India in Engineering and Technology is analysed.

Table 1 shows the development of technical training from Independent India. Training facilities are greatly enhanced for different cadres. Quantitative advancement is, no doubt, achieved. But little is known about the quality; evidently there stands no administrative control on All-India basis to enforce a minimum standard.

TABLE 1

	Year				
	1947	1950-51	1955-56	1957-58	1960-61 Target
Number of Institutions for graduate training.		49	64	83	90
Annual intakes	2900	4119	5614	9600	12915
Number of Institutions for training (Diplomas).		86	115	157	187
Annual intakes	3700	5903	10484	16000	25000
Number of Institutions for training Subordinates in Industrial training centres.		51	53	87	
Annual intakes		6221	8121	13522	30030
Ratio of annual intakes of diplomas to graduates.	1.27	1.43	1.87	1.87	1.93
Ratio of annual intakes of diplomas & subordinates to graduates.	...	2.95	3.32	3.09	
Ratio of annual outturns, diplomas & subordinates to graduates.	...	5.0	5.5	5.04	

